Text: *Dynamics – Analysis and Design of Systems in Motion* (2^{nd} Edition); Benson H. Tongue; John Wiley & Sons; 2010

Instructor: G.R. Shiflett; OHE 430F; shiflett@usc.edu

TA(s): Jakrapop Wongwiwat; VHE 202; wongwiwa@usc.edu
Zhenghong (Harris) Zhou; VHE 202; zhenghoz@usc.edu

Grading policies: *Homework*

- There will be weekly homework assignments.
- The assignments may vary in length, but all assignments will be equally weighted.
- You are encouraged to form study groups and teach one together. Piazza has been enabled for this course so you may discuss problems and share ideas asynchronously.
- Helping one another does not extend to copying someone else's work or allowing someone else to copy your work.
- Late homework loses 50% of its value per day that it is late. A grade of 0 will be assigned to homework submitted two or more days late.
- Multiple short homework problems may appear on the same page provided the problems are clearly separated.
- Long homework problems should each start at the top of a new page.
- Final answers should be neatly boxed or otherwise clearly marked at the end of each problem.
- Spiral bound note paper will not be accepted unless the fringe has been neatly removed.
- *Neatness counts!* Sloppy papers will incur an inherent penalty — if we can't read 'em, we won't grade 'em.

Quizzes

- There will be weekly quizzes based on the homework assignments.
- These quizzes will typically pose one or two problems similar to the homework followed by a set of Multiple Choice and/or Fill-in-the-Blank style questions about the problem(s). The emphasis of the questions will be on how the behavior of the system is affected by the various parameters of the problem (e.g., does the final speed increase or decrease if the value of an angle is increased). Numbers will rarely appear in either the problem statement or the answers.
- The quizzes will post on BlackBoard immediately after class on the day homework is due and will remain available until the end of the next class. If homework is due on Monday or Wednesday, you will have 48 hours to complete the associated quiz. Quizzes that post on Friday will be available for 72 hours.
- USC's Academic Integrity policy will be strictly enforced and the *slightest* hint that the work you submit is not entirely your own will result in a report to SJACS proposing an F on the quiz for all those involved.

Exams

- There will be two equally weighted exams — the first approximately midway through the term and the second on the day and time scheduled for the final. The first exam will focus on particle motion and the second exam will focus on rigid body planar motion.

Final grade calculation

- Exams will provide 40% of your grade. All exams are equally weighted.
- Your average quiz score will provide 50% of your grade. All quizzes are equally weighted.
- Your homework average will provide 10% of your grade. All homework assignments are equally weighted.

Background

If you are looking for someone to blame for this course, look no further than Isaac Newton and his seminal work, *Philosophiæ Naturalis Principia Mathematica* (often referred to simply as *The Principia*). This entire course is based upon Newton's observation that the force applied to a particle is related to the change in the linear momentum of the particle. Not coincidentally, Newton is also responsible (along with Gottfried Wilhelm von Leibniz) for the branch of mathematics known as calculus. Simple mathematical operations (like vector arithmetic), basic geometry, some algebra, and straight-forward applications of differential and integral calculus lead directly to everything else covered in the course.

Learning objectives

By the end of this course, you will have learned how to:

- solve certain types of differential equation problems involving the kinematics of single particles;
- relate the force applied to a particle to the rate of change of the linear momentum of a particle;
- use that relation to analyze the motion of a particle and the forces acting upon it in one or more directions;
- relate linear and angular impulse to changes in the linear and angular momentum of a particle;
- relate the work done by one or more forces to changes in the kinetic energy of a particle;
- extend the concepts of force/acceleration, impulse/momentum, and work/energy to closed systems of particles;
- relate the motion of one location on a rigid body to that of another; and
- extend the concepts of force/acceleration, impulse/momentum, and work/energy to one or more rigid bodies.

Course outline

This section contains a weekly plan for the semester. While not fixed in stone, this roughly illustrates what we'll be discussing each week and the work you'll be expected to complete. We may not follow the exact sequence of topics in the text — we might jump ahead at some points; return to earlier material at other points, and skip some material altogether. In general, we'll first cover all the material that applies to single particles — kinematics, Newton's Laws, the relation between work and energy, and the relations between impulse and momentum. Next, we'll look at the same material as applied to multiple particles. Finally, we'll see the same material as it is applied to rigid bodies.

Week-by-week schedule

You should note that the number of class meetings per week is not constant due to various holidays. Labor Day and the Thanksgiving holiday both affect the schedule in the Fall so Week 3 contains only two class meetings (September 5 and 7) while Week 14 has but a single meeting (November 26). These lost lecture days may affect what we can cover on those weeks — if so, we'll make appropriate adjustments as we go.

In the table that follows: Column 1 contains the week of the term; Column 2 contains the reading material for the week; Column 3 briefly describes the topics that will be discussed in class that week; and Column 4 identifies the problem assignment for the week.

Week	Suggested reading materials	Lecture topics	Problem set
1	Text: Ch. 1, Ch. 2 (§2.1) Bb: vector review handout Bb: separation of variables handout	Nomenclature; ideal systems; solvable problems [$\ddot{s} = \ddot{s}(t), \ddot{s}(s),$ and $\ddot{s}(\dot{s})$]; rectilinear motion	Problem set #1
2	Text: Ch. 2 (§2.2-5) Bb: coordinate systems handout	Curvilinear motion; Cartesian, intrinsic, cylindric, and spherical coordinate systems	Problem set #2
3	Text: Ch. 2 (§2.5-6)	Relative and constrained motion	Problem set #3
4	Text: Ch. 3 (§3.1-3) Bb: systems of particles handout (§1-2)	$\mathbf{F} = m\mathbf{a}$ for single particles	Problem set #4
5	Text: Ch. 3 (§3.4, 7) Bb: particle collision handout	Linear impulse/momentum; particle impacts	Problem set #5
6	Text: Ch. 3 (§3.5-6)	Angular impulse/momentum; central force motion	Problem set #6
7	Text: Ch. 4 (§4.1-4) Bb: conservative forces handout	Work/energy; power; conservative forces; potential energy	Problem set #7
8	Text: Ch. 5 (§5.1-6) Bb: systems of particles handout (§3)	Closed systems of particles; force, energy, and momentum	Problem set #8
9	Text: Ch. 6 (§6.1-2)	Rigid body planar kinematics; abs. and rel. vel./acc.; Joints/contact conditions	Problem set #9
10	Text: Ch. 6 (§6.5)	Rotating frames	Problem set #10
11	Text: Ch. 7 (§7.1-3) Bb: rigid body motion handout (§1-3) Bb: centers and centroids handout	$\mathbf{F} = \dot{\mathbf{L}}$ and $\mathbf{M}_O = \dot{\mathbf{H}}_O$ for rigid bodies in planar motion; 2-D constrained motion	Problem set #11
12	Text: Ch. 7 (§7.5) Bb: rigid body work/energy handout	Work/Energy for rigid bodies in planar motion	Problem set #12
13	Text: Ch. 7 (§7.4) Bb: rigid body motion handout (§4)	Impulse/Momentum for rigid bodies in planar motion;	Problem set #13

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Week	**Suggested reading materials**	**Lecture topics**	**Problem set**
		Rigid body impact	
14	Text: Ch. 8 (§8.1-4)	3-D kinematics; 3-D kinetics;	Problem set #14
15		Catch up, review, etc.	
16	Study days and Final exam		