

MAE 2323-001 DYNAMICS, Spring 2018
Department of Mechanical and Aerospace Engineering
University of Texas at Arlington

COURSE SYLLABUS

- Instructor:** Dr. Adrian Rodriguez
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- Office Hours:** TTh 11:00 a.m. – 12:30 p.m. (or by appointment)
- Course Info:** MAE 2323-001
Class location: WH 308
Class times: MWF 11:00 – 11:50 a.m.
- Description:** Dynamics is the study of how to model and predict the effect of forces in the creation of motion. This course is intended to give students a clear understanding of how to use reference points, reference frames, and coordinates to develop coordinate systems in which two-dimensional, planar, motion can be described and analyzed. Vectors and matrices are used to develop the equations of motion for a system of particles or rigid bodies using vector mechanics and energy-based methods. The course also examines impulse-momentum principles that are often used to analyze collisions.
- Student Learning Outcomes:** This course is intended to enhance students' learning in the following areas:
i) use reference points and frames as a basis for developing a description of a rigid bodies position and orientation in space,
ii) describe the position and orientation of rigid bodies in terms of vectors,
iii) differentiate position and orientation descriptions to find velocities and accelerations,
iv) express the mass properties in terms of moments and products of inertia,
v) draw free body diagram and analyze the sum of forces and moments,
vi) develop equations of motion for a system of rigid bodies using Newton-Euler dynamics,
vii) apply conservation laws to the analysis of the motion of a system of rigid bodies, and
viii) apply the principles of Impulse and Momentum to analysis of collisions.
- Textbook:** “Vector Mechanics: A Systematic Approach” by A. Bowling, 3rd ed., Aqualan Press, LLC (2017).
(*Optional*) “Engineering Mechanics Dynamics” by R.C. Hibbeler, 13th ed., Pearson Prentice Hall (2012).
- Prerequisites:** MATH 1312 (Calculus I), MATH 2425 (Calculus II) – C or better

Attendance: At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. **As the instructor of this course, I will not take attendance but periodic quizzes will be given in class, which may affect your overall grade.** However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Grading Policy:

1. Homework will be posted on Blackboard and is due at the beginning of lecture in class (STAPLED) or via Blackboard (single PDF) – otherwise it will NOT be graded. Late homework will be penalized 10% per day that it is late (max 3 days – after that it will not be accepted). Include your name and Student#.
2. All quizzes and exams will be closed book, closed notes. Final exam will be comprehensive.
3. Any makeup quiz or exam will be given only under extenuating circumstances. Please notify me at least one (1) week in advance via email if you anticipate an excused absence.
4. Students will have the option of dropping their lowest exam grade and replacing it with their quiz average – all 3 exams must be taken to be eligible.
5. Other: Discussion Forum (Blackboard)

| GRADE BREAKDOWN | | GRADING SCALE | |
|-----------------|------|---------------|-------------|
| Homework Avg. | 15% | A | 90 or above |
| Exams (3) | 60% | B | 80 – 89 |
| Final Exam | 25% | C | 70 – 79 |
| | | D | 60 – 69 |
| | | F | 59 or below |
| Total | 100% | | |

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://web.uta.edu/aao/fao/>).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with*

Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD)

www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS)

www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.*

Title IX Policy: The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.*

Academic Integrity: Students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents’ Rule* 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University (<https://www.uta.edu/conduct/>).

Any act of academic dishonesty will result in an F for this course.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding

financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as “lecture,” “seminar,” or “laboratory” shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located to the right toward the building’s central stairwell. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, view information at www.uta.edu/universitycollege/resources/index.php, or send email to resources@uta.edu.

University Tutorial & Supplemental Instruction (Ransom Hall 205): UTSI offers a variety of academic support services for undergraduate students, including: 60 minute one-on-one [tutoring](#) sessions, [Start Strong](#) Freshman tutoring program, and [Supplemental Instruction](#). Office hours are Monday-Friday 8:00am-5:00pm. For more information visit www.uta.edu/utsi or call 817-272-2617.

The IDEAS Center (2nd Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

Homework Submission Format (see sample below)

Homework will be posted on Blackboard and is due at the beginning of lecture in class (STAPLED) or via Blackboard (single PDF) – include your name and Student#. Engineering paper is not required.

ENGINEERING PROBLEM SOLVING: Your work should stand alone. Another engineer should be able to understand your work and reproduce your results using only the write up you present.

GIVEN: A brief statement of the problem to be solved. Do not rewrite the entire problem statement (this is not necessary). Demonstrate that you understand the problem description.

SKETCH: Include a good sketch of the problem, such as a free-body diagram that shows the coordinate axes, dimensions, units, etc. Include any assumptions as necessary.

FIND: Indicate the unknowns you need to solve. This will eliminate doing any unnecessary work.

SOLUTION: Indicate appropriate equations necessary to solve the problem. Neatly box solution with units and 2-3 significant digits.

The image shows a sample homework submission on engineering computation paper. The paper is filled with handwritten text, a free-body diagram, and calculations. Several yellow callout boxes with red arrows point to specific parts of the work:

- Assignment Number:** Points to "ASSIGNMENT #39" at the top.
- Course Number:** Points to "E2209" at the top.
- Names of all contributors:** Points to "T. BARTOLINNEY, LEE BARTER, RICK THAYER" at the top.
- Page Number:** Points to "Current page #/Total # 1/3" at the top.
- Staple:** Points to a staple on the left edge.
- Semester:** Points to "FALL 2000" at the top.
- Present the solution process outline:** Points to the "GIVEN:", "WANTED:", and "SOLUTION:" sections.
- Neatly drawn sketch... To SCALE using a straight edge:** Points to the free-body diagram of a cable system.
- Neat, easy to follow solution:** Points to the step-by-step calculations for forces A_1 , B_1 , and the lengths AC and BC .
- Clear, easy to find Solution Summary:** Points to the "RESULTS SUMMARY" box at the bottom.
- Engineering Computation Paper:** Points to the paper itself.

The handwritten work includes the following details:

GIVEN: TWO CABLES ARE TIED TOGETHER AT "C" AND HANGED AS SHOWN.

WANTED: DETERMINE THE TENSION IN AC AND BC.

SOLUTION:

Free-body diagram showing a cable system with points A, B, and C. A horizontal cable AB is supported by a pin at A and a roller at B. A weight of 200N is applied at point C. Cable AC connects point A to point C, and cable BC connects point B to point C. The vertical distance from AB to C is 100N. The horizontal distance from A to C is 75N, and from C to B is 125N.

Calculations:

$$\sum M_A = 0 = 200N(75) - A_1(100)$$
$$A_1 = 75N$$
$$\sum F_y = 0 = A_1 + B_1 - 200N$$
$$B_1 = 125N$$
$$\frac{A_1}{A_2} = -\frac{4}{5}$$
$$A_2 = -\frac{5}{4}A_1 = -\frac{5}{4}(75N) = -93.75N$$
$$\frac{B_1}{B_2} = \frac{3}{4}$$
$$B_2 = \frac{4}{3}B_1 = \frac{4}{3}(125N) = 166.67N$$
$$\sum F_x = 0 = A_2 + B_2 = -93.75 + 166.67 = 0 \quad \therefore \text{OK}$$

Lengths:

$$AC = \sqrt{75^2 + 100^2} = 125N$$
$$BC = \sqrt{125^2 + 100^2} = 162.5N$$

RESULTS SUMMARY:

| |
|---------------|
| $AC = 125N$ |
| $BC = 162.5N$ |

Course Schedule (*Revised: 01/16/2018*)**

Important dates: Census Date (01/31), Spring Break (03/12-03/17), Drop Date (03/30), Last Class Day (05/04)

| | Monday | Wednesday | Friday |
|----------|---------------------------------------|--|--|
| JANUARY | 15 | 17 | 19 |
| | MARTIN LUTHER KING DAY | Syllabus, Course Objectives | Class Cancelled |
| | University Closed | | |
| | 22 | 24 | 26 |
| | Lecture: Ch. 1 (Intro) | Lecture: Ch. 2 (Points, frames, directions, vectors) | Lecture: Ch. 2 (Position/orientation) Assign Homework 1 |
| FEBRUARY | 29 | 31 | 2 |
| | Lecture: Ch. 2 (Position/orientation) | Lecture: Ch. 2 (Constraints) | Lecture: Ch. 2 (Constraints) |
| | 5 | 7 | 9 |
| | Lecture: Ch. 2 (Constraints) | Lecture: Ch. 3 (Velocity) | Lecture: Ch. 3 (Velocity) |
| | Homework 1 Due, Assign HW 2 | | |
| | 12 | 14 | 16 |
| | Lecture: Ch. 3 (Velocity) | Lecture: Ch. 3 (Acceleration) | Lecture: Ch. 3 (Acceleration) |
| | Homework 2 Due, Assign HW 3 | | |
| | 19 | 21 | 23 |
| MARCH | Lecture: Ch. 3 (Acceleration) | Exam 1 Review | Exam 1: Chapters 1-3 |
| | | Homework 3 Due | |
| | 26 | 28 | 2 |
| | Lecture: Ch. 4 (Linear momentum) | Lecture: Ch. 4 (Linear momentum) | Lecture: Ch. 4 (Angular momentum) |
| | Assign Homework 4 | | |
| | 5 | 7 | 9 |
| | Lecture: Ch. 4 (Angular momentum) | Lecture: Ch. 4 (Angular momentum) | Lecture: Ch. 4 (Angular momentum) |
| | Homework 4 Due, Assign HW 5 | | |
| | 12 | 14 | 16 |
| | SPRING | BREAK | VACATION |
| | 19 | 21 | 23 |
| | Lecture: Ch. 4 (Angular momentum) | Lecture: Ch. 5 (Force and moments) | Lecture: Ch. 5 (Conservation laws) |
| | Homework 5 Due, Assign HW 6 | | |
| APRIL | 26 | 28 | 30 |
| | Lecture: Ch. 5 (Conservation laws) | Exam 2 Review | Exam 2: Chapter 4 |
| | Homework 6 Due, Assign HW 7 | | |
| | 2 | 4 | 6 |
| | Lecture: Ch. 5 (Conservation laws) | Lecture: Ch. 6 (EOM Newton-Euler) | Lecture: Ch. 6 (EOM Newton-Euler) |
| | | Homework 7 Due, Assign HW 8 | |
| | 9 | 11 | 13 |
| | Lecture: Ch. 6 (EOM Newton-Euler) | Lecture: Ch. 6 (EOM Newton-Euler) | Lecture: Ch. 6 (EOM Newton-Euler) |
| | | Homework 8 Due, Assign HW 9 | |
| | 16 | 18 | 20 |
| MAY | Lecture: Ch. 6 (Impulse-Momentum) | Lecture: Ch. 6 (Impulse-Momentum) | Lecture: Ch. 6 (Impulse-Momentum) |
| | | Homework 9 Due, Assign HW 10 | |
| | 23 | 25 | 27 |
| | Lecture: Ch. 6 (Impulse-Momentum) | Exam 3 Review | Exam 3: Chapters 5-6 |
| | | Homework 10 Due | |
| | 30 | 2 | 4 |
| | Make-up Lecture | Make-up Lecture | Make-up Lecture |
| | 7 | 9 | 11 |
| | | FINAL EXAM (11:00 am – 1:30 pm) | |

**As the instructor, I reserve the right to adjust the course schedule to serve the educational needs of the students in this course.