MECH 102 – Dynamics
Fall 2020

Course Information and Policy Document

Instructor: Subhrajit Bhattacharya (sub216)

Course Catalog Description:

Particle dynamics, work-energy, impulse-momentum, impact, systems of particles; kinematics of rigid bodies, kinetics of rigid bodies in plane motion, energy, momentum, eccentric impact.

Prerequisites: **Engineering Mechanics (MECH 002 / 003) and Calculus III (MATH 023 / 033).**

Overall Course Format:

- ***Lecture videos*** will be posted through course-site in an asynchronous manner allowing students to watch/re-watch them at their convenience. Students should watch the lecture videos before the following Zoom meeting (I will attempt to post the video the afternoon/evening before Zoom meeting during which the lecture will be discussed).
- ***Zoom meetings*** will have the format of office hours and will allow students to ask specific questions, discuss problems from the homeworks, and/or request the instructor to go over specific parts of the video lectures or specific problems described in the video lecture. The Zoom meetings will NOT be recorded.
- ***Homeworks, weekly quizzes and exams*** will all be conducted electronically (may require you to scan and upload solutions as PDF to course-site) as described below.

Lectures:

Video posted on course-site ***before*** scheduled lecture hours (MW, 10:45am-12:00).

Meetings / Office Hours:

Zoom meeting on MW, 10:45am-12:00.
Additional zoom meetings / office hours may be conducted on Fridays, 10:45am-12:00, on an as-needed basis. One-on-one Zoom office hours can be scheduled upon request / by appointment.

Text and Syllabus:

Beer, Johnston, and Cornwell, *Vector Mechanics for Engineers: Dynamics*, 11th Ed., 2016.

You need to have access to a copy of the text book. A different edition of the book should also be fine. However the 10th and earlier editions have the sections numbered differently. In this course we will cover chapters 11 to 19 of the book.

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Grading:

- The final letter grade for the class will be primarily based on the following: Homeworks & Projects (10%), Weekly Quizzes (20%), Midterm 1 (20%), Midterm 2 (20%), Final exam (25%), and Class participation (5%).
- The final letter grades will be computed relative to the entire class (using a "curve") based on the total score from homeworks, projects, quizzes and the exams: Top 20% students get A's (A / A-), next 30% get B's (B+ / B / B-), the next 30% students get C's (C+ / C / C-), etc.

Homeworks:

- Weekly homeworks will be assigned on Wednesdays and will be due on the following Wednesdays before the Zoom meeting starts. You need to submit a digital copy of your solution (scanned, if you solved the problems on paper) as a ***single PDF file*** through the couse-site.
- No late submission will be accepted. Submissions made after Zoom meeting has already begun on Wednesday or left in the mailbox of the instructor/TA will not be graded.
- The homework submissions should be your own individual work. You can discuss a problem with your class-mates before you start working on it. But **you should work out the problems by your own self, and submissions must be your own original work.**
- Although each homework will typically consist of three or four problems, you will need to submit solution to only two problems (it will be mentioned which two need to be submitted), out of which only one randomly selected problem will be graded for each homework.

Weekly Quizzes:

- Weekly quizes will be assigned through course-site on Fridays mornings. It will be a timed quiz, and you'll have 15-20 minutes to complete it once you start working on it. You will however be able to start the quiz any time until midnight of that Friday.
- You are **NOT allowed to discuss the specifics of the assigned problem(s) in a quiz with anyone (including your classmates, friends or online forums).**
- The online timed quiz on course-site will be a multiple-choice one, but submitting the multiple-choice answer online alone will not fetch you any point (*read next)*…
- ...you'll need to separately **upload your complete solution** (showing how you arrived at the answer that you selected) through the course-site as a **single PDF file**. You will need to upload the PDF file **within 1 hour** of completing the timed quiz.

Projects:

- There will be two to three projects assigned during the semester. A project will consist of a relatively long problem, possibly with some MATLAB programming components to it.
- You need to submit a digital copy of your solution (scanned, if you solved the problems on paper) as a single PDF file through the couse-site.
- The project submissions should be your own individual work. You can discuss the problem with your class-mates before you start working on it. But **you should work out the project problem by your own self, and the submissions must be your own original work.**

Exams:

- There will be two midterm exams and their syllabus will not be cumulative (*i.e.*, midterm 2 will be on the topics covered after midterm 1).
- The final exam will be comprehensive, covering all the material in the course (including topics covered on the midterms).
- The difficulty level of the questions on the exams will be similar to those of the homeworks and quizzes.
- Both the midterms and the final exam will have the format of an ***open-book, take-home exam***. You will have a window of about 24 hours to start the exam, but once you start it, you'll have 1-2 hours (depending on the exam) to complete it.
- The exams will be timed and will be about 1-2 hours long. Once you start the exam on course-site, you'll have the designated amount of time to solve the problems and type in your final (numerical) answers into the text fields of the timed question. But submitting the answer in the text fields alone will not fetch you any point (*read next)*…
- ...you'll need to separately **upload your complete solution** (showing detailed work on how you arrived at the answer that you typed in) through the course-site as a **single PDF file**. You will need to upload the PDF file **within 1 hour** of completing the timed quiz. For the exams, you will be graded primarily based on the complete solution that you upload in PDF. Only a numerical solution, even if correct, will not fetch you any point unless you have submitted a complete solution in the PDF showing the details of all the work. The answers that you enter in the text fields will only be used to cross-verify your complete solution, and any discrepancy may result in your exam being void.
- **IMPORTANT – Open-book, Take-home Exam Rules:**
  - Your solution to the exams that you submit for grading should be your own individual work. **It will be a violation of the university's academic integrity vignettes and the course policy to collaborate on or discuss solutions to such assignments with anyone, including your classmates.**
  - You are free to consult books, notes, any material shared through course-site, or any other printed/written material during the exam. You can also use the internet for reading on the topics that we have covered in the class.
  - But you are **NOT allowed to look up or search the internet for solutions to the specific problems assigned in the exam**. You are also **NOT allowed to discuss the specifics of the assigned problems with anyone (including your classmates, friends or online forums).**
  - Violation of these instructions will void your exam and will constitute a serious violation of the academic integrity principles of Lehigh University.

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Preparation for Class and Participation in Class:

- You should make best effort to join the Zoom meetings / office hours for the class.
- Before every meeting / office hour, you are expected to view the video lecture(s) posted earlier that day and read the corresponding sections from the book. The "tentative schedule" document posted on course-site contains the list of topic by day that we cover, along with

the corresponding section numbers from the book.

- Participation in the Zoom meetings / office hours (in terms of responding to questions asked by the instructor and asking questions during the meetings) is expected and encouraged.

Makeup Quizzes / Exams and Late Submissions

No make-ups will be given and no late submission will be accepted, except in documented extenuating circumstances (*e.g.*, family or personal emergency) with permission from the instructor. The student should provide the instructor an advance notice of his/her inability to complete a given assignment in order to be able to take a makeup exam/quiz, and provide valid documentation/letter issued by the Dean of Students Office. No other form of documentation will be accepted. If approved, the assignment must be completed within one week of the original date of the assignment.

Electronic Devices:

- For all assignments (homeworks, quizzes and exams), the format will be that of an "open-book, take-home" assignment. As described earlier, this means you are allowed to consult any printed, written or electronic material shared through course-site, and can also use the internet for reading on the topics that we have covered in the class. However, you are **NOT allowed to look up or search the internet for solutions to the specific problems assigned, nor are you allowed to discuss the specifics of the assigned problems with anyone (including your classmates, friends or online forums).**
- Only "Departmental Approved" calculators are permitted for performing calculations in homeworks, quizzes or exams (see Department policy and list of approved calculators posted on Course Site).

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Academic Integrity:

- Students are expected to be familiar with all the academic integrity principles of Lehigh University. Please visit the Academic Integrity Resources page for details: https://citl.lehigh.edu/academic-integrity-resources
- Please see the rest of this document for the specifics of the policies on academic integrity set forth in this course. Any violation of these policies will be considered serious violation of the academic integrity principles of Lehigh University.

Accommodations for Students with Disabilities

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in

person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at https://studentaffairs.lehigh.edu/disabilities .

The Principles of Our Equitable Community

Lehigh University endorses The Principles of Our Equitable Community [http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf]. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Learning Objectives

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Upon completion of this course, students should be able to do the following:

1. Represent position, velocity, and acceleration as vectors in rectangular coordinates , polar coordinates and tangential-normal coordinates, and work out kinematics problems using such representations.
2. Carry out dynamic analyses of particles using Newton's laws and free-body & kinetic diagrams.
3. Understand the fundamentals of impulse-momentum method, the conditions under which linear momentum is conserved, and carry out dynamic analyses of particles and system of particles using impulse-momentum methods.
4. Carry out analysis of impacts between particles using conservation of linear momentum and understand coefficient of restitution.
5. Understand angular impulse, angular momentum and central forces, and use these concepts to solve problems using angular impulse-momentum methods.
6. Understand work-energy principle, distinguish between conservative & non-conservative forces, and identify conditions under which kinetic and total energy are conserved. Solve problems using these methods.
7. Analyze relations between position, velocity and acceleration of fixed points on rotating and translating rigid bodies.
8. Analyze relations between position, velocity and acceleration of moving points on rotating and translating rigid bodies (motion with respect to a rotating frame).
9. Understand angular momentum in context of rigid bodies and carry out dynamic analyses of rigid bodies using Newton's laws (including free-body & kinetic diagrams of rigid bodies) and angular impulse-momentum methods.
10. Understand kinetic energy in context of rigid bodies and use work-energy principle for solving dynamics problems involving rigid bodies.
11. Carry out analyses of particles and rigid bodies subjected to free (unforced) vibration.
12. Carry out analyses of particles and rigid bodies subjected to forced vibration, hence understand the phenomenon of resonance.