ME 274: Basic Mechanics II – Spring 2024

School of Mechanical Engineering
Purdue University, West Lafayette

Course description Particle kinematics (both 2D and 3D motion, including moving reference frame descriptions for each). Particle kinetics including Newton's laws, work/energy and impulse/momentum. Planar kinetics of rigid bodies. Kinetics for planar motion of rigid bodies including equations of motion and principles of energy and momentum. Introduction to linear vibrations of single-degree-of-freedom systems.

Course instructors

	Lecture (MWF)	**Lecture Room**	**Office**	**Office hours**	**Email**
Luz Sotelo	8:30-9:20 am	STEW 314	MMRL 1900D*	MW 9:30-11:00 am (in ME Tutorial Room)	lsotelo@purdue.edu
Yangfan Liu	9:30-10:20 am	RAWL 1086	HLAB 1008	MW 11:00–12:00 noon F 2:30–3:30 pm**	yangfan@purdue.edu
Chuck Krousgrill	11:30 am-12:20 pm	ARMS B061	WANG 4030	MWF 12:30-1:20 pm (in PHYS 331)	krousgri@purdue.edu
	1:30-2:20 pm	PHYS 223			
James Gibert	2:30-3:20 pm	ME 1130	LMBS 2243	MWF 4:00-5:00 pm	jgibert@purdue.edu
Haotian Liu	4:30-5:20 pm	ME 1130	HLAB 2067	T/Th 1:00-2:30 pm	liu1460@purdue.edu

* *Purdue Research Park, 2550 Northwestern Avenue, West Lafayette*

** Professor Liu will have his Friday office hours in the ME 274 Tutorial Room.

Course TAs

Clark Addis	caddis@purdue.edu
Emma Balevic	ebalevic@purdue.edu
Yeongeun Ki	yki@purdue.edu
Mohit Kumar	kumar589@purdue.edu
Kunal Mamtani	kmamtani@purdue.edu
Siddharth Nair	nair40@purdue.edu
Savani Vidyadhar Prabhune	prabhune@purdue.edu
Uday Madhukar Rade	urade@purdue.edu
Zenan Zhu	zhu1134@purdue.edu

Course textbook The required course lecturebook: *Dynamics: A Lecturebook, 3rd Edition,* can be purchased from the University Bookstore.

Course website

https://www.purdue.edu/freeform/me274/

The course website will be used for both threaded discussions and for the delivery of all course material. Example problem solutions from the lecturebook are posted as multimedia video/audio files on the website. Use these solutions to help assess your ability to work the homework problems for that day. Homework video solutions will be made available on the blog following the date of submission. Animations and simulations are presented on the blog to assist you in visualizing motion and other concepts related to the topics of the course. All information related to homeworks and exams is available on the course website. Brightspace will *NOT* be used on a course-wide basis for delivering learning material.

Course schedule

A topical schedule for the course is attached at the end of this syllabus. Please use the *Daily Schedule* page on the course website to guide you through the expected daily activities as you move through the course. This page provides you with the reading assignment from the lecture book, links to lecture book example solution videos, links to related animations on concepts for the day, and daily summary sheets for the course material.

Class meetings

Your attendance is expected for all meetings during the semester. If you are unable to attend a class meeting, you are expected to contact your instructor prior to the start of the class period.

Homework

There will be a homework assignment for every regular class period of the semester. Two problems will be included in each assignment. The problem statements will be posted on the course blog on the date of the assignment. The homework is to be submitted on Gradescope by 11:59pm on the day of the next regular class period. Please see the pages on "*Homework guidelines*" and "*Homework format*" near the end of this document.

Course grading

Your course grade will be based on a straight grading scale:

97-100% A+
93-97% A
90-93% A-
87-90% B+
83-87% B
80-83% B-
77-80% C+
73-77% C
70-73% C-
67-70% D+
63-67% D
60-63% D-
<60% F

The percentage breakdown for the components of your course grade is the following:

1. *Homework and quizzes*: 25%. Two homework problems are assigned per lecture. Completed homework assignments are to the submitted on Gradescope by 11:59pm of the due date. *Late homework will not be accepted.* A sample format is

attached. Your work needs to be presented with a logical thought process and in a neat, easy-to-read style. Failure to do so can result in a loss of points in your homework grade.

2. *Midterm and final exams*: 75%. You will be given two, one-hour midterm term exams during the term and a final exam during the scheduled University final exam period. At the end of the term, the average of the two midterm exams will be compared against your final exam score. The higher of these two will be given a 50% weighting and the lower of these two will be given a 25% weighting in the computation of your course average from which your course grade is determined.

3. *Bonus points:* There will be an opportunity to earn bonus points for HW and Quizzes. Officially there are 39 homework assignments during the semester. At the end of the semester, your course homework score will be based on 36 homework assignments. That is, you are able to miss submissions for 3 homework sets without penalty to your grade, thereby providing bonus points. In addition, participation in blog discussion can allow for up to 40 homework bonus points. See attached page detailing blog points for the course. Your instructor may also announce additional bonus points for your section. Your total combined HW/Quizzes/Bonus points will not exceed 25% of your final grade.

Data Science Activities

As part of a new initiative within the School of Mechanical Engineering, you may have some data science-related activities as part of your homework assignments in the course. These activities will be graded as regular homework assignments. The activities will be in the form of interactive Jupyter notebooks. There will be a tutorial demonstrating some data science concepts applied to core concepts from this course, followed by a guided problem part in which you will have to repeat the analysis and answer related conceptual questions.

Tutorial assistance

The discussion thread of the course blog will be open 24/7 throughout the course. We will be closely monitoring this discussion thread, and you can expect a quick turn-around on your questions during normal daytime hours. During the remaining time, we will continue to monitor the discussion and provide assistance when needed. In addition, the course instructors and TAs will be providing interactive tutorial sessions/office hours. Your instructor will provide you with a schedule of tutorial/office hours during the first week of class. You are free to attend any of the office hours/tutorial sessions, as you are not restricted to just the office hours of your instructor.

Collaboration

You are encouraged to work together in learning the course material (including homework). However, your submitted homework solutions should be YOUR work and not copied from

other sources. Copying solutions from other sources will be considered to be a serious offense in this course. Please see your instructor if you are uncertain about the difference between collaborating and copying.

Usage of services such as Chegg, Course Hero, Quizlet, etc. for unauthorized help (including, but not limited to, accessing online cheating services) is a violation of class policy. The consequences of not following the course policy on this include a lowering of your course grade up through possible expulsion from the University. Suspect use cases will be submitted to the Office of the Dean of Students and, if copyright infringement is involved, to appropriate legal counsel.

Academic Integrity

Your instructor is a strong believer that the mission of the University can only be fulfilled in an environment of high academic integrity. Students are encouraged to review the University's policies on academic integrity, which is located at: *https://www.purdue.edu/odos/academic-integrity/*
In addition, the Purdue University Honor Pledge is located at: *https://www.purdue.edu/provost/teachinglearning/honor-pledge.html*
Suspected cases of academic integrity violations will be reported to the Dean of Students.

Questions?

Please see the following page entitled "*Some common questions at the start of the semester*", and/or contact your instructor.

Emergency Preparedness

Though Purdue University is continuously preparing for natural disasters and human-caused incidents with the ultimate goal of maintaining a safe and secure campus, emergency preparedness is a personal responsibility. Please review the following items:

- To report an emergency, call 911.
- To obtain updates regarding an ongoing emergency, and to sign up for Purdue Alert text messages, view *www.purdue.edu/ea*
- There are nearly 300 Emergency Telephones outdoors across campus and in parking garages that connect directly to the Purdue Police Department (PUPD). If you ever feel threatened or need help, push the button, and you will be connected immediately.
- If we hear a fire alarm, we will immediately suspend class, evacuate the building, and proceed outdoors away from the building. Do not use the elevator.
- Emergency assembly area for ME building occupants:
  - Primary: Purdue Mall area outside MSEE.
  - Secondary (in case of inclement weather): Atrium of the MSEE building, located in the center of the building's first floor.
- If we are notified of a Shelter in Place requirement for a *tornado* warning, we will suspend class and shelter in the lowest level of the ME building away from windows and doors.

- If we are notified of a Shelter in Place requirement for a *hazardous materials release*, or a *civil disturbance*, including a shooting or other use of weapons, we will suspend class and shelter in our classroom, shutting any open doors or windows, locking or securing the door, and turning off the lights. If you are directed to shelter in place, but you are unaware of the specific reason, proceed to the lowest level of the building but continue to seek additional information by all possible means to determine the type of incident. Once you have determined the type of emergency, follow the below chart:

Emergency	***Emergency Assembly Area (EAA)***
Weather-Related / Tornado Warning	Basement corridors, basement offices, basement restrooms or the lowest level of the building (stay away from windows and doors)
Hazardous Materials (HAZMAT) Release	Remain or find an unaffected office or work area and close windows and doors
Civil Disturbance / Active Shooter	Seek a safe location, preferably a room without windows that can be locked or secured by barriers

Please review the Emergency Preparedness website for additional information:
http://www.purdue.edu/ehps/emergency_preparedness/index.html

Diversity & Inclusion Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue's nondiscrimination policy can be found at: http://www.purdue.edu/purdue/ea_eou_statement.html.

CAPS information Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Accessibility Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

ME 274 – Course Blog

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The blog discussion threads for this course are intended to provide a forum for the exchange of ideas among the students in the class and between the students and the instructor. From this blog, you can get/provide assistance from/to other people in the class. We have found that you can often learn as much from helping others as from getting help for yourself.

REWARD:

To reward your involvement in the blog, up to *40 BONUS points* to your homework/quiz score is available based on the following:

> *Asking questions and providing assistance to others.* For this, you ask/answer questions of others on a comment or post. A minimum of six quality comments will count as full credit toward your blog point bonus. *Only blog activity **prior to** the last day of class will count toward your blog participation reward.*

Your total combined HW/Quizzes/Bonus points will not exceed 25% of your final grade.

ANONYMITY IN POSTING:

When you first log onto the course blog and are approved by your instructor, your default *User Name* is set to that of your Purdue Career Account. This *User Name* will appear with each comment that you post on the blog. If you would like to post anonymously, you are able to choose a new "*Nickname*" that will be displayed instead of your *User Name* on the comments. To do so:

1. Go to your "**Edit my profile**" in the upper right of the Admin Bar under "**Howdy**".
2. Add a nickname in the "**Nickname**" (*required*)" box.
3. In the "**Display name publicly as**", choose the desired nickname from the drop-down list.
4. Click "**Update Profile**" at the bottom of the page.

You may add additional *Nicknames*, and switch among these for different displays throughout the semester. If being anonymous to your colleagues is important to you for your postings, choose nicknames that will help you maintain your anonymity.

Some common questions at the start of the semester

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Are homeworks and quizzes very important in the course?

To do well in this course, your development of problem-solving skills through homework and quizzes is essential. 25% of your final grade in the course comes from your homework assignments and quizzes.

Where can I find the homework assignments?

The homework will be posted on the course website (www.purdue.edu/freeform/me274) under the Homework/Discussion link.

Where can I get help with homework?

The course website can be used 24/7 for any questions regarding the course. Homework assistance is also available in the ME 274 tutorial room and instructor office hours. Staffed hours of operation will be announced in class.

What is the appropriate homework format?

Homework must be submitted in the correct format, as shown on the attached sheet in this handout. In particular, you must include statements of "Given" and "Find", and your sketch of the problem, when a figure is supplied in the problem statement.

How do I submit the homework?

Homework will be submitted via Gradescope and is due at 11:59 PM on the day of the next regular class period after it is assigned. Homework is to be submitted as a scan or by direct electronic inking on a tablet. ***The submission format must be a SINGLE PDF file. Do not submit image files such as JPEG, PNG, TIFF, etc.*** You may use your mobile device to make a PDF scan the homework, e.g., with the scanning functionality of Dropbox, or apps such as Camscan or Scannable.

Is late homework accepted?

No late homework will be accepted.

How is each homework set graded?

Each homework set consists of two problems and has a maximum possible grade of 10. One of the two problems is chosen on each set for grading.

Are there extra credit (bonus points) opportunities?

Yes, there are a number of ways of receiving bonus points in the course.

- You are allowed to miss 3 of the 39 homework sets for the semester without a loss of points. If you submit more than 36 homework sets, these will count toward bonus points.
- You can receive up to 40 homework bonus points in the course for blog participation. Please see the Blog Participation page of this handout.
- You can receive bonus points for participating in the mid-term and end-of-semester course evaluations. Contact your instructor for more information.

What is the format of the quizzes?

Quizzes will not be announced. The specific quiz policy for your course section will be explained by the instructors during class.

Homework guidelines

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- The two problems of each homework set must be written on separate pages, with each problem starting on a new sheet of paper. These pages should be scanned together into a single PDF file and uploaded to Gradescope. Each scanned page must be assigned to the correct problem in chronological order within Gradescope. And, we suggest that, in order to make your record keeping easier, you name the file "*ME274_Problem Number_ Your Name*".
- While homework is due just before midnight, you should set yourself a goal of submitting it between 6:00-7:00 pm, at the latest, so that internet challenges can be identified soon enough to develop other strategies for uploading on time. If you have problems uploading your homework to Gradescope for a homework set, be sure to email your homework submission to your instructor before the 11:59 pm deadline. *Late homework is not accepted*.
- If you use multiple sheets of paper to solve a problem repeat the *DATE*/*PROBLEM NUMBER*/*PAGE*/*NAME* header on each sheet.
- Before scanning, put the pages in order and scan from the first to the last sheet of paper. Be sure that all scans are appropriately aligned on a "portrait" page alignment.
- Before uploading to Gradescope, check the quality of the scanned problem. You do not want to lose points because the grader is unable to read your solution. If it is hard to read, you need to rescan and make sure the result is better.
- Your writing needs to be large enough so that when the problem is scanned, it does not require the grader to do high levels of magnification to be able to read your solution.
- If you are using a pencil in writing your solution, you need to use a pencil that is on the soft side (HB at a minimum or 2B ideally) so that the writing is dark enough so that the scan works well. Make sure that the pencil is sharpened, too.
- You must use the unit vector and other standard notation used in this class. Do not use the "bracket notation" for vectors. For example, use $\vec{F} = \left(10\hat{i} + 20\hat{j}\right) lb$ instead of $\vec{F} = \langle 10,20 \rangle lb$.

  You must specify co-ordinate systems, associated reference points, draw the unit vectors that you are using on the diagrams, and include units in your answers.
- For all problems, you must include statements of "*Given*" and "*Find*", and include a figure for the problem.
- For kinetics problems, you must also clearly indicate the four steps in your solution: 1) *Free body diagrams*; 2) *Kinetics equations*; 3) *Kinematics*; 4) *Solve*.
- It is recommended that you solve the homework problems in symbolic form, and then substitute in numerical values for parameters (when provided) in the final steps of your solution. It is *required* that your final numerical solution be written in decimal form using no more than three significant figures.
- It is important to follow all formatting guidelines above. *Failure to do any of these things will result in a loss of points. Failure to do all of these things will result in a large loss of points.*

Homework format

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Please use paper for your homework problem solutions that allow for clear scans. For example, avoid using paper with grid markings as this often produces poor, illegible scans.

***DUE DATE** (month, day, year)* ***PROBLEM NO.** (H#.#)* ***PAGE NO.** (# of #)* ***NAME** (last, first)*

***Given*:** A concise statement (in your own words) of the information given.

***Find*:** A concise statement (in your own words) of the information sought.

***Solution*:** **Sketch the system** to be studied. USE A STRAIGHT EDGE for drawing lines. Always draw in the UNIT VECTORS for the coordinate systems that you use in your solution.

For kinetics problems, follow the four-step plan:

1. Draw FBD's.
2. Write down the fundamental kinetics equations (Newton/Euler, work/energy, linear impulse/momentum, angular impulse momentum equations).
3. Kinematics.
4. Solve.

Solve the problem symbolically.
At the end convert all quantities to a consistent set of units and substitute into the equations to obtain the final numerical answers (when numerical values for parameters are provided).

Check your answers for correctness and feasibility.

Check your vector notation and units. In particular, check that you are not equating vector quantities to scalar quantities. It is important that you demonstrate that you know the difference between scalars and vectors. So pay attention to your notation.

Label the answers._____ANSWER

Assignment Schedule – Spring 2024

ME 274 - BASIC MECHANICS II

School of Mechanical Engineering - Purdue University

PERIOD		DATE	TOPIC	READING	HOMEWORK
KINEMATICS					
1	M	1/8	Point Kinematics – Cartesian description	1.A	H.1.A, H.1.B
2	W	1/10	Point Kinematics – Path description	1.A	H.1.C, H.1.D
3	F	1/12	Point Kinematics – Polar description	1.A	H.1.E, H1.F
	M	1/15	***University Holiday - no class meeting***		
4	W	1/17	Point Kinematics – Joint description	1.C	H.1.G, H.1.H
5	F	1/19	Point Kinematics – Relative and Constrained Motion	1.D	H.1.I, H.1.J
6	M	1/22	Planar Kinematics – Rigid Bodies	2.A	H.2.A, H.2.B
7	W	1/24	Planar Kinematics – Rigid Bodies	2.A	H.2.C, H.2.D
8	F	1/26	Planar Kinematics – Rigid Bodies	2.A	H.2.E, H.2.F
9	M	1/29	Planar Kinematics – Instant Centers	2.B	H.2.G, H.2.H
10	W	1/31	Planar Kinematics – Rigid Body Summary	2.C	H.2.I, H.2.J
11	F	2/2	Moving Reference Frame Kinematics – 2D	3.A	H.3.A, H.3.B
12	M	2/5	Moving Reference Frame Kinematics – 2D	3.A	H.3.C, H.3.D
13	W	2/7	Moving Reference Frame Kinematics – 3D	3.B	H.3.E, H.3.F
14	F	2/9	Moving Reference Frame Kinematics – 3D	3.B	H.3.G, H.3.H
15	M	2/12	Moving Reference Frame Kinematics – 3D	3.B	H.3.I, H.3.J
	W	2/14	***No class meeting due to evening exam***		
	W	2/14	***Exam 1 - 6:30PM***		
16	F	2/16	Particle Kinetics – Newton's Second Law	4.A	H.4.A, H.4.B
KINETICS					
17	M	2/19	Particle Kinetics – Newton's Second Law	4.A	H.4.C, H.4.D
18	W	2/21	Particle Kinetics – Newton's Second Law	4.A	H.4.E, H.4.F
19	F	2/23	Particle Kinetics – Work/Energy	4.B	H.4.G, H.4.H
20	M	2/26	Particle Kinetics – Work/Energy	4.B	H.4.I, H.4.J
21	W	2/28	Particle Kinetics – Linear Impulse/Momentum	4.C	H.4.K, H.4.L
22	F	3/1	Particle Kinetics – Linear Impulse/Momentum	4.C	H.4.M, H.4.N
23	M	3/4	Particle Kinetics – Central Impact	4.C	H.4.O, H.4.P
24	W	3/6	Particle Kinetics – Angular Impulse/Momentum	4.D	H.4.Q, H.4.R
25	F	3/8	Particle Kinetics – Angular Impulse/Momentum	4.D	H.4.S, H.4.T
Spring Break - March 11-17 - no classes					
26	M	3/18	Particle Kinetics – Summary	4.A-D	H.4.U, H.4.V
27	W	3/20	Planar Kinetics of Rigid Bodies – Newton/Euler Equations	5.A	H.5.A, H.5.B
28	F	3/22	Planar Kinetics of Rigid Bodies – Newton/Euler Equations	5.A	H.5.C, H.5.D
29	M	3/25	Planar Kinetics of Rigid Bodies – Newton/Euler Equations	5.A	H.5.E, H.5.F
30	W	3/27	Planar Kinetics of Rigid Bodies – Work/Energy	5.B	H.5.G, H.5.H
31	F	3/29	Planar Kinetics of Rigid Bodies – Work/Energy	5.B	H.5.I, H.5.J
32	M	4/1	Planar Kinetics of Rigid Bodies – Impulse/Momentum	5.C	H.5.K, H.5.L
	T	4/2	***Exam 2 - 8:00PM***		
	W	4/3	***No class meeting due to evening exam***		
33	F	4/5	Planar Kinetics of Rigid Bodies – Impulse/Momentum	5.C	H.5.M, H.5.N
34	M	4/8	Planar Kinetics of Rigid Bodies – Summary	5.A-D	H.5.O, H.5.P
VIBRATIONS					
35	W	4/10	Vibrations – Equations of Motion	6.A	H.6.A, H.6.B
36	F	4/12	Vibrations – Free, Undamped Response	6.B	H.6.C, H.6.D
37	M	4/15	Vibrations – Free, Damped Response	6.B	H.6.E, H.6.F
38	W	4/17	Vibrations – Free, Damped Response	6.B	H.6.G, H.6.H
39	F	4/19	Vibrations – Harmonic Excitation	6.C	H.6.I*, H.6.J*
40	M	4/22	Vibrations – Harmonic Excitation	6.C	H.6.K**, H.6.L**
41	W	4/24	Vibrations – Harmonic Excitation	6.C	H.6.M**, H.6.N**
42	F	4/26	Course Overview		

Final Examination: During the final examination period (4/29-5/4). Date, time, and location TBA during the semester.

Homework Assignments: Homework problems are due on Gradescope by 11:59 pm on the day of the next regular class period after they are assigned. ()* denotes homework due at 11:59 pm on Sunday, 4/21. ()** denotes homework that will NOT be collected.

Solution Videos: Solution videos are provided for the assigned problems above on the course website after the due date.