Mechanical Engineering 345: Engineering Dynamics

Course Information:
(3-0) Cr. 3..Particle and rigid body kinematics, Newton's laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear and angular impulse-momentum principles, vibrations.

Learning Outcomes:

Upon successful completion of this course students should have the knowledge to:

- Calculate the velocity and acceleration of a particle in rectangular coordinates, in polar coordinates, in normal/tangential coordinates.
- Relate the velocity and acceleration of points in a rigid body using the absolute motion approach and using the relative motion approach.
- Solve particle kinetics problems using Newton's second law, work-energy, and/or impulse-momentum methods.
- Solve rigid-body planar motion problems using Euler's equations, work-energy, and/or impulse-momentum methods.
- Solve particle and rigid-body impact problems.
- Solve one-degree-of-freedom vibration problems of particles in un-damped and damped free vibration.

Meeting times:

Section 5:	**online**	Tuesday, Thursday	2:10 --	3:25	PM
Section 6:	**online**	Tuesday, Thursday	11:00 –	12:10	PM

Prerequisites:
- Credit earned in EM 274 – Statics of Engineering (or approved substitute)
- Credit or enrollment in MATH 266 or MATH 267

It is the policy of the College of Engineering and the Department of Mechanical Engineering to require all students enrolled in this course to have satisfied all of the course's prerequisite requirements. If it is discovered that a student has not met any applicable prerequisite requirements, he/she will be required to immediately drop the course. The failure to drop the course will result in a final course grade of 'F', regardless of course performance. Students who discover they have improperly enrolled in a course without meeting the applicable prerequisite requirements are strongly encouraged to meet with advising staff to promptly drop the course and make alternative scheduling arrangements or discuss if an official waiver of the pre-requisite requirements may be applicable.

Instructor: Dr. Gloria Starns gkstarns@iastate.edu Ph: 515-294-9946 (O)

Virtual Office Hours via WEBEX: Tuesday and Thursdays, during class time
And By Appointment

Required Textbook:
- *Vector Mechanics for Engineers: Dynamics* 12th ed., Ferdinand Beer, E. Johnston, Phillip Cornwell and Brian Self, McGraw Hill 2019

Other Resources: McGraw-Hill Connect license for the above textbook; Top Hat license; Zoom and Webex software from ISU; Scientific calculator; Ability to scan calculations to PDF file.

Class-time Procedures & Policies

Expectations:

- Read the assigned articles in the textbook (once) prior to “class time”.
- Login to class prepared and ready for any synchronous work.
- Your attendance via webex is expected for the duration of every class time.
- Be professional, respectful and courteous with everyone while online.
- Ask questions / seek help when you don't understand. (This semester will require you to be more proactive than usual).
- Demonstrate your understanding of the material by concise and well-reasoned assignments and exams. Write legibly.

Synchronous (real-time) Assignments

Synchronous Assignments may be pre-announced, but usually will be UNANNOUNCED. The intent is an interactive learning experience during regular class time. These will be done through Top Hat Pro (see next subsection). Participation partial credit will often be included. These assignments are to be completed during normal class time, and are submitted on a timed basis. Exceptions (due to class absence) include ISU sanctioned field trips (rare this semester), bereavement, or other reasons which you have pre-notified the instructor and that have been OK'd. Illness is certainly also a valid reason, but we may ask for some proof of medical diagnosis or treatment. In these exceptions, a substitute non-synchronous make-up exercise will be provided. The substitute make-up exercise does not qualify for participation partial credit.

Top-Hat Active Learning System

We will be using the Top Hat Pro (www.tophat.com) classroom response system in class. You will be able to submit answers to in-class questions using a PC at home, or even via Apple or Android smartphones

You can visit the Top Hat Overview (https://success.tophat.com/s/article/Student-Top-Hat-Overview-and-Getting-Started-Guide) within the Top Hat Success Center which outlines how you will register for a Top Hat account, as well as providing a brief overview to get you up and running on the system.

If you are not already a licensed Top Hat Pro user, you can register by simply visiting our course website: https://app.tophat.com/e/### where ### are [ ] the Section Join Codes for Section 5 and 6, respectively.

Top Hat may require a paid subscription (almost everyone already has one) and a full breakdown of all subscription options available can be found here: www.tophat.com/pricing.

Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email (support@tophat.com), the in app support button, or by calling 1-888-663-5491.

Outside of Classtime

After-class Assignments
Top Hat Pro also has a mode where an assignment can be given a fixed due date & time. Sometimes the Dynamics topic material does not work well with timed synchronous learning. Additionally, in a normal classroom setting I typically let people work together. After-class assignments allow you to have such interaction, before submitting your answers into Top Hat. Due dates will generally be PRIOR to the next class.

After-class & Supplemental Homework Virtual Groups

1) For the purpose of aiding the completion of After-Class Assignments and Supplemental Homework, this section will form Study Groups of 4 students. You are also welcome to confer with your group-mates for Dynamics Learning in general. But not on exams.
2) Group formation: if there is a person you would like to work with, contact that person and see if you both agree. ONLY THEN, one of you please send me an email at gkstarns@iastate.edu making this request and COPY your colleague. This email must be sent by 5 PM Friday January 25th
3) I will randomly group these pairs into groups of 4 and include everyone who did not make a specific request.
4) Face to Face interaction is strongly DISCOURAGED
5) All group work can be accomplished by Zoom, IM, Facetime, etc.

On-line Homework System
The "McGraw-Hill Connect" system is produced by your textbook publisher, and a license was included in your Immediate Access. Homework associated with the Topics of a given week are due before 8 PM on the subsequent Monday. Graded homework done after the due-date accrues no score. Each problem's questions will allow 10 repetitions of the "Check My Work" step so that you have ample opportunity to eliminate conceptual or calculation errors and obtain the correct answer at full credit. The best strategy is to do the LearnSmart activity before tackling the Topic problems.

Supplemental Homework
During the semester there with be Supplemental Homework problems assigned most weeks. These problems with be distributed via Canvas, and are generally more complicated than After-class assignments. Due dates will generally be 7 days later. Credit for solving these problems will only be granted for complete hand-written (*in your handwriting*) solutions. A logical solution sequence with proper details is expected. Correctness and reasonable legibility with be considered in scoring.

- Please utilize 8.5x11 paper (plain white or lightly ruled engineering problems paper – for good contrast when scanned). Write your name, course number, assignment number (or date) and EXAM ID # at the beginning of each uploaded file.
- Show all your intermediate calculations in a legible and organized fashion.
- Box or underline your final answer(s) and include proper units.
- Results must be uploaded as a PDF file into Canvas. NO PICTURE formats (*e.g.*, jpeg, heic, png) or TIFF, html, etc.
- Evidence of submitting work generated by (in whole, or in part, or copied from) college homework service firms, such as Chegg®, will be considered Academic Dishonesty (see page 7), and at a minimum will result in a ZERO score for that Assignment.
- Late homework will not be accepted.

Supplemental Instruction:
There is no Supplemental Instruction for Engineering Dynamics

Graduate Student Teaching Assistants:
At this time there is no scheduled Teaching Assistant (TA) Office Hours. Be sure to take advantage of your instructor's Virtual Office Hours instead.

Night Exams
All sections of ME 345 have three common evening mid-term exams on the dates shown later in the Schedule. These exams will be conducted online. Make-up exams will only be provided in cases where the student has an ISU night class during that time, or for cases of ISU sanctioned field trips, bereavement, or illness. It is the student's responsibility to notify the instructor of the inability to attend the regular exam PRIOR TO the scheduled time. The Instructor may then approve a substitute make-up exam. In situations of an ISU night class conflict, this notification must be made before the end of the second week of class. Each of these exams are 90 minutes (8:15 to 9:45 PM), but you will have a larger time window to access the exam, scan your work, and upload. http://www.registrar.iastate.edu/students/exams/fall-night-exams

Course Grade

EXAM ID

This course assigns a unique 3-character EXAM ID number to each student. This number (#) avoids using your longer and more private Student ID number. To ensure proper credit, please include that number on all uploaded homework and examination files. Your number will be listed in MyGrades of Canvas by February 2.

Course Activities Weighting

Percentage	Description
30 %	Exams 1 to 3; 10% each
10 %	Final Exam
35 %	Online Homework via McGraw Hill Connect & Supplemental Homework
25 %	In-Class Assignments & Quizzes and After-Class Assignments
100%	TOTAL

Letter Grade Assignment Policy

Letter grades will be given only for mid-term reports (if applicable) and the Final Course Grade, and will be no lower than that determined the following grading scale:

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

Lecture Topic Outline / Schedule

#	Week		Topic	Readings	MH Homework
1	1	T 1/26 R 1/28	Introduction; position, velocity, accel.	**11.1A**	**11.33, 11.36**
2			Particle motion	**11.1B** to **11.2B**	**11.39, 11.45**
3			Relative & constrained motion	**11.2C** & **11.3**	**11.47, 11.51, 11.53**
4	2	T 2/2 R 2/4	Curvilinear motion of particles	**11.4**	**11.94, 11.97, 11.99**
5			Normal & tangential coordinates	**11.5A**	**11.138, 141, 145**
6			Radial & transverse components	**11.5B**	**11.161, 11.166**
7	3	T 2/9 R 2/11	Particle kinetics & linear momentum	**12.1A, B & C**	**12.31, 12.39, 12.46**
8			Equations of motion	**12.1D**	**12.53, 12.54, 12.64**
9			Particle angular momentum	**12.2A**	**12.74, 12.77**
10	4	T 2/16 **R 2/18**	Gravitation and Review for EXAM 1	**12.2C**	**12.78, 12.80, 12.87**
			NIGHT EXAM 1 (Topics 1 – 10)		
11			Work and energy of particles	**13.1A, B & C**	**13.03, 13.22, 13.27**
12	5	T 2/23 R 2/25	Conservation of energy	**13.2A, B** & **C**	**13.64, 13.74, 13.110**
13			Impulse and momentum	**13.3**	**13.126, 144 & 145**
14			Direct central & oblique impact	**13.4A** & **B**	**13.162, 13.168**
15	6	T 3/2 R 3/4	Problems with multiple principles	**13.4C**	**13.175, 184 & 188**
16			Translation & fixed axis rotation	**15.1**	**15.10, 15.24, 15.29**
17			General plane motion: Velocity	**15.2**	**15.40, 15.64, 15.70**
18	7	T 3/9 R 3/11	Instantaneous center of 0 velocity	**15.3**	**15.76, 15.84**
19			Review for EXAM 2		
20			General plane motion: Accel #1	**15.4**	**15.107, 116 & 119**
	8	T 3/16 R 3/18	**Exam, Monday, 3/15**		
			NIGHT EXAM 2 (Topics 11 - 19)		
21			General plane motion: Accel #2	**15.4**	**15.125, 15.134**
22			Mass Moments of Inertia	**9.5A, B, C, & E**	**9.127, 133, 142**
23	9	T 3/23 R 3/25	General equations of motion	**16.1A, B** & **C**	**16.6, 16.10, 16.12**
24			Solution of RB kinetics problems	**16.1E** & **F**	**16.16, 16.38, 16.48**
25			Constrained motion: fixed axis rotation	**16.2**	**16.84, 16.88, 16.89**
26	10	T 3/30 R 4/1	Constrained motion: rolling #1	**16.2**	**16.98, 16.108, 16.109**
27			Constrained motion: rolling #2		**16.100, 16.107, 111**
28			General plane motion #1	**16.2**	**16.119, 123, 135**
29	11	T 4/6 R 4/8	General plane motion #2		**??**
30			Review for EXAM 3		
31			Work-energy of rigid bodies #1	**17.1A** to **17.1E**	**17.05, 17.09, 17.17**
	12	T 4/13 R 4/15	**Monday, April 12**		
			NIGHT EXAM 3 (Topics 20 – 30)		
32			Work-energy of rigid bodies #2	**17.1A** to **17.1E**	**17.18, 17.28, 17.43**
33			Impulse-momentum of rigid bodies #1	**17.2**	**17.69, 17.72, 17.82**

NOTES:

Review Sessions will have Practice (UNGRADED) homework

Lecture Topic Outline / Schedule *continued*

#	Week		Topic	Readings	MH Homework
34	13	4/20	Impulse-momentum of rigid bodies #2	**17.2**	**?**
35		4/22	Vibration; harmonic motion	**19.1**	**19.11, 19.19, 19.31a**
36			Un-damped free vibrations of Rigid Bodies	**19.2**	**19.41, 19.70, 19.79**
37	14	4/27	Damped vibrations	**19.5A**	**19.132, 19.133, 138**
38		4/29	Energy Methods for Rigid Body Vibration	**19.3**	**?**
39			Review for EXAM 4		
FINAL EXAMINATION: (TBD)					

Connect Homework for Topics 38 and LearnSmart for Week 14 are due by 8 PM ???.

NOTES:

Review Sessions will have Practice (UNGRADED) homework

University Procedures & Policies

COVID-19 health and safety requirements

Students are responsible for abiding by the university's COVID-19 health and safety expectations . All students attending this class in-person are required to follow university policy regarding health, safety, and face coverings:

- wear a cloth face covering in all university classrooms, laboratories, studios, and other in-person instructional settings and learning spaces. Cloth face coverings are additionally required to be worn indoors in all university buildings, and outdoors when other people are or may be present where physical distancing of at least 6 feet from others is not possible. Students with a documented health or medical condition that prevents them from wearing a cloth face covering should consult with Student Accessibility Services in the Dean of Students Office.
- ensure that the cloth face covering completely covers the nose and mouth and fits snugly against the side of the face.
- practice physical distancing to the extent possible.
- assist in maintaining a clean and sanitary environment.
- not attend class if you are sick or experiencing symptoms of COVID-19.
- not attend class if you have been told to self-isolate or quarantine by a health official.
- follow the instructor's guidance with respect to these requirements. Failure to comply constitutes disruptive classroom conduct. Faculty and teaching assistants have the authority to deny a non-compliant student entry into a classroom, laboratory, studio, conference room, office, or other learning space.

These requirements extend outside of scheduled class time, including coursework in laboratories, studios, and other learning spaces, and to field trips. These requirements may be revised by the university at any time during the semester.

In accordance with university policy, instructors may use a face shield while they are teaching as long as they are able to maintain 8 feet of physical distance between themselves and students during the entire instructional period. Some form of face covering must be worn at all times in learning spaces regardless of the amount of physical distancing.

Faculty may refer matters of non-compliance to the Dean of Students Office for disciplinary action, which can include restrictions on access to, or use of, university facilities; removal from university housing; required transition to remote-only instruction; involuntary disenrollment from one or more in-person courses; and other such measures as necessary to promote the health and safety of campus.

It is important for students to recognize their responsibility in promoting the health and safety of the Iowa State University community, through actions both on- and off-campus. The university's faculty asks that you personally demonstrate a commitment to our Cyclones Care campaign. Iowa State University's faculty support the Cyclones Care campaign and ask you personally to demonstrate a commitment to our campaign. Your dedication and contribution to the campaign will also protect your family, classmates, and friends, as well as their friends and families. Our best opportunity for a successful fall semester with in-person learning and extramural activities requires all of us to collaborate and fully participate in the Cyclones Care campaign.

Academic Integrity:

As professionals, we must always strive to uphold standards of honesty and integrity. ASME, the Mechanical Engineering professional society, has adopted a code of ethics in order to define our commitments. This class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office. Find additional information at: http://www.dso.iastate.edu/ja/academic/misconduct.html

Academic Freedom and Freedom of Speech:

Iowa State University supports and uphold the First Amendment protection of freedom of speech the principle of academic freedom in order to foster a learning environment where open inquiry and the vigorous debate of diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

Accessibility:

Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. Students requesting accommodations for a documented disability are required to work directly with staff in Student Accessibility Services (SAS) to establish eligibility and learn about related processes before accommodations will be identified. After eligibility is established, SAS staff will create and issue a Notification Letter for each course listing approved reasonable accommodations. This document will be made available to the student and instructor either electronically or in hard-copy every semester. Students and instructors are encouraged to review contents of the Notification Letters as early in the semester as possible to identify a specific, timely plan to deliver/receive the indicated accommodations. Reasonable accommodations are not retroactive in nature and are not intended to be an unfair advantage. Additional information or assistance is available online at www.sas.dso.iastate.edu, by contacting SAS staff by email at accessibility@iastate.edu, or by calling 515-294-7220. Student Accessibility Services is a unit in the Dean of Students Office located at 1076 Student Services Building.

Harassment and Discrimination:

Iowa State University does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. Veteran. Inquiries regarding non-discrimination policies may be directed to Office of Equal Opportunity, 3410 Beardshear Hall, 515 Morrill Road, Ames, Iowa 50011, Tel. 515-294-7612, Hotline 515-294-1222, email eooffice@iastate.edu

Prep Week: *(formerly known as Dead Week)*

This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook.

ISU's Principles of Community

Students are responsible for living the tenets established in ISU's Principles of Community: Respect, Purpose, Cooperation, Richness of Diversity, Freedom from discrimination, and the Honest and respectful expression of ideas. Visit ISU's Principles of Community website (http://www.diversity.iastate.edu/principles-of-community)

Religious Accommodation:

Iowa State University welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. In all cases, you must put your request in writing. The instructor will review the situation in an effort to provide a reasonable accommodation when possible to do so without fundamentally altering a course. For students, you should first discuss the conflict and your requested accommodation with your professor at the earliest possible time. You or your instructor may also seek assistance from the Dean of Students Office at 515-294-1020 or the Office of Equal Opportunity at 515-294-7612.

Contact Information for Academic Issues

If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu