Fall
2020

SCUPI
Sichuan University - Pittsburgh Institute

ME1015 Rigid Body Dynamics

Instructor: Jangho Yoon, Ph.D.
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Office hours: Tue: 12:30 ~ 13:30 PM and Wed: 12:30 ~ 14:30 or by an appointment
Class time: Thursday: 08:15 - 11:00 AM
Class location: Teaching Building 1 A608

Catalog Description: This is 3 credit hour course intended to introduce students to the motion of particles and rigid bodies. Students are expected to develop an understanding of the fundamental principles of applied kinematics for particles and rigid bodies in engineering dynamics, and demonstrate an integrated understanding of engineering dynamics principles through applications involving problem solving and through creation of design solutions to engineering scenarios.

Course Objective At the end of the course, the student will be able to:

- Interpret the geometry and physical meaning of mechanical systems by drawing diagrams (free body diagrams and kinematic diagrams)
- Apply several governing methods (Newton laws, work-energy, impulse-momentum) to study mechanical systems
- Analyze and predict the kinematics and kinetics of a body using various reference frame

Prerequisites: MATH 0240 Analytic Geometry & Calculus 3
ENGR 0135 Statics & Mechanics of Materials I

Textbook: J.L. Meriam and L.G. Kraige, Engineering Mechanics Dynamics. 8th edition, John Wiley & Sons, Inc. New York, 2010.

Reference: R. C. Hibbler, Engineering Mechanics - Dynamics, Prentice-Hall

Topics Covered:

1. Kinematics in Normal, Cylindrical & Tangential Coordinates
2. Absolute & Relative Motion
3. Kinetics: Equations of Motion
4. Principle of Work & Energy for Particles
5. Linear Impulse & Momentum
6. Angular Impulse & Momentum
7. Relative Velocity & Acceleration of Rigid Bodies
8. Moment of Inertia
9. Work and Energy for Rigid Bodies
10. Motion of a Rigid Body
11. Moments and Products of Inertia
12. Angular Momentum & Kinetic Energy

Grades

Weekly Homework	10 %
In-Class Work	10 %
Two Term Exams	40 % (20 % each, tentatively scheduled on Nov 5 and Dec 10)
One Final exam	40 % (Final Week)

While grades may be curved, there is no guarantee of any curve. However, a student will have to reach 50 % of the total number of possible points in order to receive a grade of D or better and to become eligible for make-up exam. In the absence of a curve the grading scale is

	$A > 90\%$	$A^- > 85\%$
$B^+ > 80\%$	$B > 76\%$	$B^- > 73\%$
$C^+ > 70\%$	$C > 66\%$	$C^- > 63\%$
$D^+ > 61\%$	$D = 60\%$	$F < 60\%$

Homework, In-Class Work and Exams

There will be homework assigned on weekly base, and it must be submitted to Black Board on time. Absolutely **NO late homework will be accepted** unless an arrangement is made with the instruction well ahead of the due date. The two lowest homework scores will be dropped from your grade.

I strongly encourage for students to work on homework on their own since doing homework independently will reinforce and extend the knowledge of the material learned in class. Students are also encouraged to work with your classmates. Should you have any trouble with the homework, ask the instructor for help during designated office hours.

In each class, you will be assigned a number of problems to help you practice and learn the material. You will work on and complete these problems as a team or as an individual during the class period. Some of them will be collected and graded.

There will be **two term exams** and **a final exam**. The final exam is comprehensive. The exams in this course will be closed book and closed note. Students will be given a formula sheet containing all the necessary formula.

If you miss any exam, NO make-up will be given for the missing exam *without prior* arrangement. If you have a serious conflict with an exam time, you MUST discuss it with the INSTRUCTOR well ahead of the scheduled exam day to make an appropriate arrangement. Exams missed due to unpredictable events such as a family emergency and a traffic accident will be dealt with on a case-by-case basis if the student has a proper document(s) to prove it.

Students have one week after the any graded work of any kind including exams is returned or the grad is posted on BB to bring up any questions regarding the grading discrepancy.

It is important that you show the work in an organized manner clearly showing your thought process in solving the given question. Instructor cannot give points for the answer(s) that is(are) not readable and/or understandable. For homework, always staple pages together and do not write on the back of paper.

Make sure that you use appropriate units for all of your any of your work such as homework, project and exam, or you will **be penalized** for any missed unit or wrong unit, and also be **penalized** for using excessive number of significant figures

e.g., $\pi = 3.1415926535897932385$ instead of $\pi = 3.14$

Collaboration:

Collaboration between students is strongly encouraged for better understanding of the course material. Students are allowed to discuss homework problems and projects in terms of **methodologies**, but **not the solutions** of a problem, which means that each student MUST do the actual work independently. Inappropriate collaboration (also known as cheating) includes

- Using all or parts of homework, exams or projects from this year or any previous year
- Sharing of work such as graphs, equations, calculations or any other derived material that was not presented to the class
- Talking, passing information or using inappropriate materials during an exam Anyone found to be participating in inappropriate collaboration may be immediately failed from the course.

Office Hours:

Office hours are times I have specifically set aside to be available to students. During office hours, you can come to my office; you don't need an appointment. I may be available at other times; please email to schedule a time, or simply drop by, outside these times.

Be prepared to show me what work you have done and try not to ask vague questions

Attendance:

On-time attendance at all class activities is expected. Attendance itself will not be graded, but the student is responsible for any material that was covered, and any changes to the exam dates and homework assignments announced in class. Make-up work will only be accepted if prior arrangement has been made or if a valid emergency excuse (e.g., meteor strike) is accompanied by appropriate documentation.

Other Policies:

Please honor the following: do not come late; do not disturb the class by having conservation with others; turn off all cell phones and electronic gadgets; do not work on any other class materials.

Those students who fail to follow these policies may be asked to leave the class.

The instructor also reserves the right to extend credit for alternative assignments, projects, or presentations.

The instructor reserves the right to make changes to this syllabus as needed. All changes will be announced via Blackboard and/or announced in class.

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Class Week	Chapter	Topic
1 (Sep 7)	Ch. 1	Introduction - Basic Concepts, Newton's Law, Units
2 (Sep 14)	Ch. 2.1 ~ Ch. 2.5	Rectilinear & Curvilinear Motion in Rectangular and Normal & Tangential Coordinates
3 (Sep 21)	Ch. 2.6 ~ Ch. 2.8	Polar Coordinates, Space Curvilinear Motion and Relative Motion
4 (Sep 28)	**No Class（中秋节，国庆节)**	
TBA	Ch. 3.1 ~ Ch. 3.4	Kinetics - Equation of Motion and Rectilinear Motion
6 (Oct 12)	Ch. 3.5 ~ Ch. 3.7	Curvilinear Motion, Work & Kinetic Energy, and Potential Energy
7 (Oct 19)	Ch. 3.8 ~ Ch. 3.12	Impulse & Momentum and Impact
8 (Oct 26)	Ch. 4.1 ~ Ch. 4.3	Generalized Newton's Law, Work-Energy
9 (Nov 2)	**Exam I (Nov. 5)**	
10 (Nov 9)	Ch. 4.4 ~ Ch. 4.5	Impulse-Momentum, Conservation of Energy and Momentum
11 (Nov 16)	Ch. 5.1 ~ Ch. 5.4	Rotation, Absolute Motion and Relative Velocity
12 (Nov 23)	Ch. 5.5 ~ Ch. 5.6	Instantaneous Center of Velocity and Relative Acceleration
13 (Nov 30)	Ch. 6.1 ~ Ch. 6.3	Force, Mass, and Acceleration I
14 (Dec 7)	**Exam II (Dec. 10)**	
15 (Dec 14)	Ch. 6.4 ~ Ch. 6.5	Force, Mass, and Acceleration II
16 (Dec 21)	Ch. 6.6 ~ Ch. 6.7	Work & Energy and Impulse & Momentum I
17 (Dec 28)	Ch. 6.7 ~ Ch. 6.8	Work & Energy and Impulse & Momentum II
18 (Jan 4)	**Final Exam**	