ENS214 Dynamics
Sabanci University 2021-22 (Spring)

Instructor Adnan Kefal (adnankefal@sabanciuniv.edu)
Teaching Asst. Abdullah Kendibilir (kendibilir@sabanciuniv.edu)
Mohammadamin Abdollahzadeh (abdollahzadeh@sabanciuniv.edu)
Muhammed Yavuz Belur (yavuz.belur@sabanciuniv.edu)
Elham Yousefimiab (yousefimiab@sabanciuniv.edu)

Schedule

- **ENS 214** (Courses will be conducted hybrid: Physical + Zoom)

Wednesday at 8:40 am – 10:30 am (Adnan Kefal) – FMAN 1099
Friday at 8:40 am – 9:30 am (Adnan Kefal) – FASS G062

- **ENS 214R** (Recitations will be online: 4 simultaneous sessions)

Friday 10:40 am – 12:30 pm

Credits 3 SU Credit / 6.00 ECTS / 42 Teaching Hours
Prerequisite ENS 204 - Mechanics

Objectives

This course is designed for undergraduate students to (i) develop an understanding of particle and planar rigid body kinematics and kinetics (ii) obtain an understanding of Newton's Laws of Motion, and (iii) gain the ability to apply energy and momentum methods to particles and rigid bodies in planar motion.

Learning Outcomes

At the conclusion of this course, students should be able to:

1. Understand the basic kinematics concepts: displacement, velocity, and acceleration (and their angular counterparts)
2. Draw free-body diagram for a particle or a rigid body in motion
3. Understand the basic concepts of force, momentum, and energy
4. Understand and be able to apply Newton's laws of motion
5. Understand and be able to apply work-energy, impulse-momentum principle
6. Extend all of concepts of linear kinetics to systems in general plane motion

Course Content

Weeks & Lectures	Topic
Week 1 (02.03.2022– 04.03.2022) Week 2 (09.03.2022– 11.03.2022)	**KINEMATICS OF A PARTICLE** Introduction, Rectilinear Kinematics, General Curvilinear Motion, Curvilinear Motion: Rectangular Components, Motion of a Projectile, Normal and Tangential, Component, Cylindrical Components, Absolute Dependent and Relative-Motion Motion Analysis of Two Particles.

Week 3 (16.03.2022– 18.03.2022) **(Quiz 1)** Week 4 (23.03.2022– 25.03.2022) Week 5 (30.03.2022– 01.04.2022)	**KINETICS OF A PARTICLE** **Force and Acceleration** Newton's Second Law of Motion, The Equation of Motion, Rectangular Coordinates, Normal and Tangential Coordinates, Cylindrical Coordinates, Central-Force Motion and Space Mechanics **Work and Energy** Work of a Force, Principle of Work and Energy, Power and Efficiency, Conservative Forces and Potential Energy, Conservation of Energy **Impulse and Momentum** Principle of Linear Impulse and Momentum, Conservation of Linear Momentum for a System of Particles, Impact, Angular Momentum, Principle of Angular Impulse and Momentum
Week 6 – 06.04.2022 – 08.04.2022 **(Quiz 2)** Week 7 – 13.04.2022 – 15.04.2022 **(Midterm 1)** Week 8 – 20.04.2022 – 22.04.2022	**PLANAR KINEMATICS OF A RIGID BODY** Planar Rigid-Body Motion, Translation, Rotation about a Fixed Axis, Absolute and Relative Motion Analysis: Velocity, Instantaneous Center of Zero Velocity, Acceleration, Relative-Motion Analysis using Rotating Axes
Week 9 – 27.04.2022 – 29.04.2022 **(Quiz 3)** **Spring Break** **(02.05.2022-08.05.2022)** Week 10 –11.05.2022 – 13.05.2022 Week 11 – 18.05.2022 – 20.05.2022	**PLANAR KINETICS OF A RIGID BODY** **Force and Acceleration** Mass Moment of Inertia, Planar Kinetic Equations of Motion, Equations of Motion: Translation, Rotation about a Fixed Axis and General Plane Motion **Work and Energy** Kinetic Energy, The Work of a Force, The Work of a Couple Moment, Principle of Work and Energy, Conservation of Energy **Impulse and Momentum** Linear and Angular Momentum, Principle of Impulse and Momentum, Conservation of Momentum, Impact
Week 12 – 25.05.2022 – 27.05.2022 **(Quiz 4)** Week 13 – 01.06.2022 – 03.06.2022 **(Midterm 2)**	**THREE-DIMENSIONAL KINEMATICS OF A RIGID BODY** Rotation About a Fixed Point, The Time Derivative of a Vector Measured from Either a Fixed or Translating-Rotating System, General Motion, Relative-Motion Analysis Using Translating and Rotating Axes
Weeks 14 – 08.06.2022 – 10.06.2022	**THREE-DIMENSIONAL KINETICS OF A RIGID BODY** Moments and Products of Inertia, Angular Momentum, Kinetic Energy, Equations of Motion, Gyroscopic Motion, Torque-Free Motion

Final Exams Week – 11.06.2021 – 23.06.2021	**FINAL EXAM**

Books and References

Main Textbook:

1. Hibbeler, R.C., 2013. Engineering mechanics: dynamics. Pearson Education.

Other References:

1. Meriam, J.L., Kraige, L.G. and Bolton, J.N., 2020. Engineering mechanics: dynamics. John Wiley & Sons.
2. Edition, E., Beer, F.P., Johnston Jr, E.R., Cornwell, P.J. and Self, B.P., 2020. Vector Mechanics for Engineers: Dynamics. New York: McGraw-Hill.

Assessment Criteria

Quizzes (4×5%), Midterm Exams I-II (2×20%), Final Exam (40%)

- *Quizzes will be conducted during recitation sessions.*

Course Material

The outline of lecture notes, project guidelines, and other course-related material will be posted at the SUCourse site (https://sucourse.sabanciuniv.edu/).