ENGR R135: DYNAMICS

Originator
jwmiller

College
Oxnard College

Discipline (CB01A)
ENGR - Engineering

Course Number (CB01B)
R135

Course Title (CB02)
Dynamics

Banner/Short Title
Dynamics

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course addresses the kinematics and dynamics of particles and rigid bodies in two and three dimensions. Topics considered include universal gravitation, conservation laws, work-energy and impulse-momentum relations, and mechanical vibration.

Taxonomy of Programs (TOP) Code (CB03)
0901.00 - Engineering, General (requires Calculus) (Transfer)

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
Will not be required

Grading method
Letter Graded

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
52.5
Total Maximum Contact/In-Class Hours
52.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
157.5
Total Maximum Student Learning Hours
157.5

Minimum Units (CB07)
3
Maximum Units (CB06)
3

Prerequisites
ENGR R130

Requisite Justification

Requisite Type
Prerequisite

Requisite
ENGR R130

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	A student will be able to predict the behavior and motion of a system under the action of forces.
2	A student will be able to describe the motion of bodies under the influence of forces both conceptually and mathematically.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	Derive and apply the relationships between position, velocity, and acceleration of a particle in rectilinear and curvilinear motion.
2	Derive relations defining the velocity and acceleration of any particle on a rigid body for translation, rotation and general plane motion.
3	Apply Newton's second law to analyze the motion of both a particle in rectilinear or curvilinear translation acted upon by forces and a rigid body in plane motion acted upon by forces and moments.

4	Apply the method of work and energy to engineering problems modeled as a single particle, a system of particles, or a rigid body in plane motion.
5	Apply the method of impulse and momentum to engineering problems modeled as a single particle, as system of particles, or a rigid body in plane motion.
6	Select the method of analysis that is best suited for the solution of a given problem. (Newton's Law, Work and Energy, Impulse and Momentum, or a combination of these methods.)
7	Describe and analyze the plane motion of a particle relative to a rotating frame. Determine the Coriolis acceleration in plane motion.
8	Apply the principle of impulse and momentum to problems of direct and oblique central impact, as well as eccentric impact.
9	To effectively communicate legible engineering solutions to be understood by engineers both in and out of their specific disciplines.

Course Content

Lecture/Course Content

1. Kinematics of Particles
   a. Rectilinear Motion of Particles
      i. Position, Velocity, and Acceleration
      ii. Determination of the Motion of a Particle
      iii. Uniform Rectilinear Motion
      iv. Uniformly Accelerated Rectilinear Motion
      v. Motion of Several Particles
      vi. Graphical Solution of Rectilinear-Motion Problems
   b. Curvilinear Motion of Particles
      i. Position Vector, Velocity, and Acceleration
      ii. Derivatives of Vector Functions
      iii. Rectangular Components of Velocity and Acceleration
      iv. Motion Relative to a Frame in Translation
      v. Tangential and Normal Components
      vi. Radial and Transverse Components
2. Kinetics of Particles: Newton's Second Law
   a. Newton's Second Law of Motion
   b. Linear Momentum of a Particle and Rate of Change of Linear Momentum
   c. Systems of Units
   d. Equations of Motion
   e. Dynamic Equilibrium
   f. Angular Momentum of a Particle and Rate of Change of Angular Momentum
   g. Equations of Motion in Terms of Radial and Transverse Components
   h. Motion Under a Central Force and Conservation of Angular Momentum
   i. Newton's Law of Gravitation
3. Kinetics of Particles: Energy and Momentum Methods
   a. Work of a Force
   b. Kinetic Energy of a Particle and the Principle of Work and Energy
   c. Applications of the Principle of Work and Energy
   d. Power and Efficiency
   e. Potential Energy
   f. Conservative Forces
   g. Conservation of Energy
   h. Motion Under a Conservative Central Force and Application to Space Mechanics
   i. Principle of Impulse and Momentum
   j. Impulsive Motion
   k. Impact
   l. Direct Central Impact
   m. Oblique Central Impact
4. Systems of Particles

a. Application of Newton's Laws to the Motion of a System of Particles and Effective Forces
b. Linear and Angular Momentum of a System of Particles
c. Motion of the Mass Center of a System of Particles
d. Angular Momentum of a System of Particles About Its Mass Center
e. Conservation of Momentum for a System of Particles
f. Kinetic Energy of a System of Particles
g. Work-Energy Principle. Conservation of Energy for a System of Particles
h. Principle of Impulse and Momentum for a System of Particles

5. Kinematics of Rigid Bodies
   a. Translation
   b. Rotation About a Fixed Axis
   c. Equations Defining the Rotation of a Rigid Body About a Fixed Axis
   d. General Plane Motion
   e. Absolute and Relative Velocity in Plane Motion
   f. Instantaneous Center of Rotation in Plane Motion
   g. Absolute and Relative Acceleration in Plane Motion
   h. Rate of Change of a Vector with Respect to a Rotating Frame
   i. Plane Motion of a Particle Relative to a Rotating Frame and Coriolis Acceleration
6. Plane Motion of Rigid Bodies: Forces and Accelerations
   a. Equations of Motion for a Rigid Body
   b. Angular Momentum of a Rigid Body in Plane Motion
   c. Plane Motion of a Rigid Body and D'Alembert's Principle
   d. A Remark on the Axioms of the Mechanics of Rigid Bodies
   e. Solution of Problems Involving the Motion of a Rigid Body
   f. Systems of Rigid Bodies
   g. Constrained Plane Motion
7. Plane Motion of Rigid Bodies: Energy and Momentum Methods
   a. Principle of Work and Energy for a Rigid Body
   b. Work of Forces Acting on a Rigid Body
   c. Kinetic Energy of a Rigid Body in Plane Motion
   d. Systems of Rigid Bodies
   e. Conservation of Energy
   f. Power
   g. Principle of Impulse and Momentum for the Plane Motion of a Rigid Body
   h. Systems of Rigid Bodies
   i. Conservation of Angular Momentum
   j. Impulsive Motion
   k. Eccentric Impact
8. Mechanical Vibrations
   a. Free Vibrations of Particles and Simple Harmonic Motion
   b. Simple Pendulum (Approximate Solution)
   c. Free Vibrations of Rigid Bodies
   d. Application of the Principle of Conservation of Energy
   e. Forced Vibrations

Laboratory or Activity Content

None

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises
Written expression

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Objective exams
Other (specify)

Problem-Solving Assignments
Problem-solving exams
Quizzes

Other

Essays

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Computer-aided presentations
Distance Education
Demonstrations
Instructor-guided interpretation and analysis
Lecture
Small group activities

Describe specific examples of the methods the instructor will use:

1. Computer aided presentation: The instructor may employ the computer to aid in the presentation of course materials which would include simulations of specific phenomena such as the distribution of forces across the area of an object and computerized graphical representations of aspects of a system such as the variance of internal structural forces with respect to the location of an applied force.
2. Demonstrations: The instructor will demonstrate physical engineering principals by employing equipment and other items such as fulcrum. For instance; when studying static equilibrium of an object in the presence of external torques, a fulcrum, meter stick, and masses can be used to show the balancing effects required.
3. Distance Education (Lecture): When applicable, recordings of lectures will be used to convey subject matter. Also, the use of discussion boards and virtual meetings will be used to allow students to ask questions regarding the course and its material.
4. Instructor guided analysis: The instructor will work through engineering problems during lecture that investigate a given system in which the students will follow along, answering questions posed by the instructor. This will also serve as a forum for students to ask particular questions regarding the logic and methods employed to come to certain conclusions regarding said problem/system.
5. Lecture: The instructor will deliver the course subject matter via in person lectures to the students. For example, a lecture on static equilibrium.
6. Small group activities: These may be employed in the form of group quizzes where students work together in small groups to solve some engineering problems regarding current material.

Representative Course Assignments

Writing Assignments

1. Answers to short explanatory (conceptual) questions from the textbook, often assigned from among those at the end of each chapter or posed by the instructor, generally assigned weekly; a typical question might be “Regarding the diagrams shown, analyze and explain why each given system is, or is not, in static equilibrium.

Critical Thinking Assignments

1. Answering a wide array of homework, quiz, and exam questions requiring the analysis of a given physical system or circumstance in order to come to the correct conclusion and/or answer regarding the question and/or desired outcome. For instance; given an operational diagram, what amount of torque must gear #3 exert if the system is to obtain a rotational rate of 4000 RPM in a time 3.00 s when starting from rest?

Reading Assignments

1. Regular textbook readings that reinforce the concepts discussed or demonstrated during the class meetings; these readings generally include theory and principles, descriptions of the important engineering feats, data tables, definitions, problem-solving examples, and practical applications of engineering in everyday life and in specialized environments.

Skills Demonstrations

None

Other assignments (if applicable)

None

Outside Assignments

Representative Outside Assignments

1. Assigned reading from the textbook typically amounting to 1 chapter a week. This will amount to 1.5 hours per week of reading.
2. Assigned conceptual and problem solving based homework that further investigates and explores the notions and theories discussed throughout the course. Typically, homework sets will require 4.5 hours to fully complete and will be due on a weekly basis.
3. Studying and preparing for quizzes and exams.

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type

Textbook

Description

Beer, F., & Johnston, R.E., & Cornwell, P. & Self, B. & Mazurek, D. (2019). *Vector Mechanics for Engineers: Dynamics* (12th). New York, McGraw-Hill Education.

Distance Education Addendum

Definitions

Distance Education Modalities

Hybrid (51%–99% online)
Hybrid (1%–50% online)
100% online

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.

Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.

Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.
Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class problem.
Asynchronous Dialog (e.g., discussion board)	The Students will have access to a discussion board in which they can ask questions regarding the course material.
Face to Face (by student request; cannot be required)	Face to face meetings can be arranged when needed.

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.
Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class problem.
Asynchronous Dialog (e.g., discussion board)	The Students will have access to a discussion board in which they can ask questions regarding the course material.
Face to Face (by student request; cannot be required)	Face to face meetings can be arranged when needed.

100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.

Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class problem.
Asynchronous Dialog (e.g., discussion board)	The Students will have access to a discussion board in which they can ask questions regarding the course material.

Examinations

Hybrid (1%–50% online) Modality
Online
On campus

Hybrid (51%–99% online) Modality
Online
On campus

Primary Minimum Qualification
ENGINEERING

Review and Approval Dates

Department Chair
09/04/2020

Dean
09/04/2020

Technical Review
09/23/2020

Curriculum Committee
09/23/2020

Curriculum Committee
11/25/2020

CCCCO
MM/DD/YYYY

Control Number
CCC000599712

DOE/accreditation approval date
MM/DD/YYYY