ENGR M18: ENGINEERING DYNAMICS

Originator
srelle

College
Moorpark College

Discipline (CB01A)
ENGR - Engineering

Course Number (CB01B)
M18

Course Title (CB02)
Engineering Dynamics

Banner/Short Title
Engineering Dynamics

Credit Type
Credit

Start Term
Spring 2020

Catalog Course Description
Studies fundamentals of kinematics and kinetics in describing the motion of particles and rigid bodies, and introduces the concepts of free and forced mechanical vibrations. Investigates kinematics principles for analyzing rectilinear and curvilinear motion of particles and plane motion of rigid bodies. Uses kinetics principles, including Newton's laws of motion, work-energy and impulse-momentum principles, to examine causes of motion and to predict the type of motion caused by the application of forces. Studies mechanical vibrations of particles and rigid bodies in terms of simple harmonic motion.

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)
2 - Not 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

Alternate grading methods
Student Option- Letter/Pass
Pass/No Pass Grading

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 M16

Entrance Skills

Prerequisite Course Objectives
ENGR M16-communicate effectively and legibly the formulation of solutions to engineering problems that can be understood by engineers within and outside of their specific disciplines.
ENGR M16-determine the forces that act on rigid bodies and their effects on the equilibrium of rigid bodies including external forces, weight, normal and frictional forces, distributed loads, and reactions at supports.
ENGR M16-calculate internal forces and stresses in rigid bodies and create shear and bending moment diagrams for beams.
ENGR M16-perform vector analysis to determine the net effect of forces, bending moments, and torques acting on rigid bodies, trusses, frames, machines, beams, and shafts.
ENGR M16-analyze two- and three-dimensional force systems and moments acting on rigid bodies in static equilibrium.

Requisite Justification

Requisite Type
Prerequisite

Requisite
ENGR M16

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	apply concepts of displacement, velocity, constant acceleration, and curvilinear motion of particles as both scalar and vector quantities.
2	analyze rigid body motion in two dimensions with respect to both absolute and relative motion descriptions.

3	demonstrate an understanding of Newton's laws of motion and apply them to typical engineering problems involving particle kinetics and rigid body kinetics in-plane motion.
4	employ work-energy and impulse-momentum principles in solving engineering problems involving plane motion as an alternative method to Newton's laws of motion.
5	employ engineering problem solving techniques and the engineering design process to design, analyze, build, and present a mass projectile.

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 a system of particles, or a rigid body in plane motion.
6	identify and apply 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 and 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	analyze problems, synthesize solutions, and effectively communicate those engineering solutions so that they can be understood by engineers both in and out of their specific disciplines.

Course Content

Lecture/Course Content

1. **(10%) Fundamental concepts of rectilinear motion of particles**
   a. position
   b. velocity
   c. constant acceleration
   d. variable acceleration
   e. review of vectors
2. **(10%) Kinematics of particles and systems of particles**
3. **(15%) Fundamental concepts of rectilinear and curvilinear motion of particles**
   a. position
   b. velocity
   c. acceleration
   d. tangential and normal components
   e. radial and transverse components
4. **(5%) Relative motion and constrained motion of connected particles**
5. **(10%) Kinematics of rigid bodies**
   a. absolute and relative motion
   b. rotation
   c. plane motion
6. **(15%) Kinetics of particles**
   a. Newton's laws of motion
   b. work-energy principle
   c. linear and angular momentum
   d. impulse-momentum principle
   e. impact, central force
7. **(15%) Kinetics of systems of particles**

   a. Newton's laws of motion
   b. work-energy principle
   c. linear and angular momentum
   d. impulse-momentum principle
8. **(15%) Kinetics of rigid bodies**
   a. Newton's laws of motion
   b. work-energy principle
   c. impulse and momentum
9. **(5%) Mechanical vibrations**
   a. free and forced vibrations, simple harmonic motion

(optional) 3-D Motion of Rigid Bodies - interspersed within the lecture topics above

Laboratory or Activity Content

Not applicable.

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
Skills demonstrations
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):

Classroom Discussion
Group projects
Individual projects
Objective exams
Oral presentations
Projects
Problem-solving exams
Participation
Quizzes
Reports/Papers/Journals
Reports/papers
Research papers
Skills demonstrations

Instructional Methodology

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

Audio-visual presentations
Computer-aided presentations
Collaborative group work
Class activities
Class discussions
Distance Education
Demonstrations
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Internet research
Lecture
Small group activities

Describe specific examples of the methods the instructor will use:

Instructor will use demonstrations, audio/visual presentations, class discussions, and small group activities to explain the course content. In addition, the instructor will model problem solving, and how to interpret and analyze the verbal and graphical information provided in each problem. Furthermore, the instructor will help students develop a sense for evaluating the reasonableness of their computed answers to the problems.

Representative Course Assignments

Writing Assignments

1. Answer concept questions from lectures, such as: Can an object have increasing speed while its acceleration is decreasing? If so, give an example; if not, explain why. Discuss similarities and differences between kinetic energy and momentum. Compare simple harmonic motion with uniform circular motion.

2. Answer problem solving exam questions, such as: Determine the reaction forces at the roller and the hinge of the chute when grain falls from the hopper above the chute at a rate of 240 lb/s hitting the chute with a velocity of 20 ft/s and leaving the chute with a velocity of 15 ft/s. The chute makes an angle of 10 degrees with the horizontal and it is capable of supporting a weight of 600 lbs at its center of mass, including its own weight and the weight of the grain.

3. Write a technical report for the assigned design project, such as: Write a case history report documenting the design and construction process of a spring- loaded mass launcher. Include in the report your design calculations, problems encountered during the design and construction stages of your project, and the steps taken to solve them.

Critical Thinking Assignments

1. Apply knowledge of physics, mathematics, and engineering to derive formulas used in dynamics, such as: Using relations between angular coordinates, angular velocity, and time, derive the kinematics equations used for defining the rotation of a rigid body about a fixed axis.

2. Analyze and synthesize concepts and problems in engineering dynamics and critically evaluate the results, such as: Car A was traveling west at a speed of 15 m/s and car B was traveling north at an unknown speed when they slammed into each other at an intersection. Upon investigation it was found that after the crash the two cars got stuck and skidded off at an angle of 50 degrees north of east. Knowing the masses of the cars as m_A and m_B, respectively, draw the impulse-momentum diagram that can be used to determine the velocity of Car B before the impact, solve for the velocity of Car B.

Reading Assignments

1. Read handouts provided by the instructor regarding the rules, expectations, and constraints of the Mass Projectile design project, including the technical writing guidelines.
2. Read and study selected chapters from the textbook and the accompanying lecture notes, then answer questions or solve problems assigned by the instructor. An example would be: Read the chapter on Planar Kinematics of Rigid Bodies, review the lecture notes, and then characterize the motion of each rigid body depicted in exercise 1. Provide an explanation for your answer.

Skills Demonstrations

1. Demonstrate problem solving skills by applying relevant concepts in physics, engineering, and mathematics.
2. Demonstrate the ability to work in a group to complete the assigned design project.

Outside Assignments

Representative Outside Assignments

1. Homework assignments corresponding to the lecture topics covered in class. Each assignment will include at least one problem with greater than average difficulty which may require analysis tools beyond the textbook. An example could be: Use a computational software to determine and plot, for angles between 0 and 180 degrees, the velocity and acceleration of the piston of an engine system whose crank shaft rotates with a constant angular velocity of 1000 rpm clockwise and has dimensions of length=160 mm and diameter=60 mm.

2. Design projects which may include library and/or Internet research with extensive theoretical and analytical investigations of rigid body motion. An example could be: Design, analyze, and construct a device to measure the mass moments of inertia of various objects.

Articulation

C-ID Descriptor Number

ENGR 230

Status

Aligned

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU East Bay	ENGR 2120	Engineering Dynamics	3
University of California Santa Barbara	ME 16	Engineering Mechanics: Dynamics	4
Cal Poly Pomona	ME 215	Vector Dynamics	4

University of California Los Angeles	MECH and AE 102	Dynamics of Particles and Rigid Bodies	4 qtr
Cal Poly San Luis Obispo	ME 212	Engineering Dynamics	3

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Santa Monica College	ENGR 16	Dynamics	3
College of the Canyons	ENGR 155	Dynamics	3
Pasadena City College	ENGR 17	Dynamics	3
Santa Barbara City College	ENGR 116	Dynamics	4
East Los Angeles College	ENG GEN 231	Dynamics	3

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

Course is CSU transferable
Yes

CSU Baccalaureate List effective term:
S'2015

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:

UC TCA

UC TCA
Approved

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

Classic Textbook
No

Description
Beer, Ferdinand P., et al. *Vector Mechanics for Engineers: Dynamics.* 12th ed., McGraw-Hill, 2018.

Resource Type
Textbook

Classic Textbook
No

Description
Pytel, Andrew, and Jaan Kiusalaas. *Engineering Mechanics: Dynamics.* 4th ed., Cengage Learning, 2016.

Resource Type
Textbook

Classic Textbook
No

Description
Hibbeler, Russell. *Engineering Mechanics: Dynamics.* 14th ed., Pearson, 2015.

Library Resources

Assignments requiring library resources
Design projects, homework assignments with greater than average difficulty.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Research using the Library's print and online resources to find relevant information for the design and construction of the spring-loaded mass launcher project, or other instructor- assigned dynamics design projects.

Distance Education Addendum

Definitions

Distance Education Modalities

Hybrid (51–99% online)
Hybrid (1–50% 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
Asynchronous Dialog (e.g., discussion board)	Instructor will post a dynamics problem with 2 or 3 different methods of solving the problem. Instructor will then invite the students to comment on each methodology in terms of their application of the appropriate engineering problem solving techniques, and suggest ways to improve the solutions to the posed problem. Instructor may also require students to be present on-line for certain number of hours per week and have a dialogue with one another; for example, a student may post a question about solving a problem and other students will try to answer his/her question.
E-mail	Instructor will email students with announcements about the course or an upcoming event. Students in turn may email the instructor with their questions or concerns. Depending on the situation, the students may also email their assignments or projects directly to the instructor, instead of posting it on the class web page.
Face to Face (by student request; cannot be required)	Students will have the option to meet the instructor in his/her office on campus in a classroom to work on problem solving exercises in the presence of the instructor to get one-on-one help from the instructor. Also, the students may want to meet the instructor to have a face-to-face discussion about an issue of concern.
Other DE (e.g., recorded lectures)	Instructor may record the lectures and post them for students to view within a specified time frame to be ready for the accompanying problem solving assignments. Students will upload their assignments to the course webpage to be graded by the instructor.
Synchronous Dialog (e.g., online chat)	Instructor may be available on a certain day or days of the week within a certain time frame to help students and answer their questions via an online chat. This would be the equivalent of on-line office hours. Instructor may also require students to be present on-line during certain hours of the week and have a dialogue with one another; for example, a student may post a question about solving a problem and other students will try to answer his/her question. This would be a live discussion session.
Telephone	Instructor may provide a phone number to the students where they can leave a voicemail and expect a call back within 24 hours.

Video Conferencing	Instructor may be available on a certain day or days of the week within a certain time frame to help students and answer their questions via live video conferencing. This would be the equivalent of on-line office hours. Also, the instructor may choose to present a lecture to the students via video conferencing.

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
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Examinations

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

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

Primary Minimum Qualification
ENGINEERING

Review and Approval Dates

Department Chair
10/11/2019

Dean
10/12/2019

Technical Review
10/17/2019

Curriculum Committee
11/05/2019

DTRW-I
11/14/2019

Curriculum Committee
MM/DD/YYYY

Board
12/17/2019

CCCCO
01/28/2020

Control Number
CCC000612477

DOE/accreditation approval date
MM/DD/YYYY