EL CAMINO COLLEGE
COURSE OUTLINE OF RECORD – Approved

General Course Information

Subject:	**ENGR**
Course Number:	**10**
Descriptive Title:	**Dynamics**
Course Disciplines:	**Engineering**
Division:	**Mathematical Sciences**
Department:	**Engineering**

Catalog Description:
In this course, students will explore fundamentals of kinematics, kinetics of particles, and rigid bodies. Topics include kinematics of particle motion and planar motions of rigid bodies, work-energy and momentum principles for rigid body motion, and mechanical vibrations will be studied.

Conditions of Enrollment:
Prerequisite: Engineering 9 with a minimum grade of C

Course Length: Full Term

Hours Lecture (per week):	3
Hours Laboratory (per week):	0
Outside Study Hours:	6
Total Hours:	54
Course Units:	3

Grading Method:	**Letter Grade only**
Credit Status:	**Credit, degree applicable**

Transfer CSU:	**X Effective Date: 6/21/2021**
Transfer UC:	**Proposed**

General Education
ECC: Area 6 – Mathematics Competency
Term: **Other:**

CSU GE: Area B4 – Physical Universe and it's Life Forms: Mathematics/Quantitative Reasoning
Term: **Other:**

IGETC: Area 2A – Mathematics Concepts and Quantitative Reasoning
Term: **Other:**

OUTCOMES AND OBJECTIVES

A. Student Learning Outcomes SLOs (The course student learning outcomes are listed below.

1. Kinetics of Particles and Rigid bodies: Define basic kinetics of particles: Newton's second law, work, kinetic energy, impulse, momentum, gravitational and elastic potential energy.

2. Kinematics of Particles and Rigid bodies: Describe basics of rectilinear and curvilinear motion of particles, and a rigid body in plane motion acted upon by forces and moments.

3. Vibrations: Free and forces vibrations with and without damping

B. Course Objectives **(The major learning objectives for this course are listed below.)**

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, a rigid body in plane motion, or a system of forces and moments to an equivalent system at another point of a body.
5. Apply the method of impulse and momentum to engineering problems modeled as a single particle, as system of particles, 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 distributed forces, shear forces, and moments in beams; draw diagrams of distributed forces, shear forces, and moments.
8. Apply the principle of impulse and momentum to problems of direct and oblique central impact, as well as eccentric impact.
9. Effectively communicate legible engineering solutions to be understood by engineers both in and out of their specific disciplines involving problems using energy methods.

OUTLINE OF SUBJECT MATTER

(Topics should be detailed enough to enable an instructor to determine the major areas that should be covered to ensure consistency from instructor to instructor and semester to semester.)

Major Topics:

I. Rectilinear motion (6 hours, lecture)

1. A. Kinematics of particles
2. B. Rectilinear motion of particles
3. C. Special cases and Relative motion

II. Curvilinear motion (6 hours, lecture)

1. A. Curvilinear motion of particles
2. B. Non-rectangular Components
3. C. Special cases

III. Newton's Second Law of Motion (6 hours, lecture)

1. A. Newton's Second Law
2. B. Linear Momentum
3. C. Angular Momentum and orbital motion

IV. Work and energy (6 hours, lecture)

1. A. Work
2. B. Energy
3. C. Conservation of energy

V. Impulse and momentum (6 hours, lecture)

1. A. Impulse
2. B. Momentum
3. C. Impact

VI. Kinematics of systems of particles (7 hours, lecture)

1. A. System of particles
2. B. Applying Newton's Second Law and Momentum Principles to System of Particles
3. C. Energy and Momentum Methods for a System of Particles

VII. Kinematics of rigid bodies (7 hours, lecture)

1. A. Translation and Fixed Axis Rotation
2. B. General Plane Motion: Velocity
3. C. General Motion: Acceleration
4. D. Plane Motion of Rigid Bodies: Forces and Acceleration

VIII. Kinetics of plane motion (6 hours, lecture)

1. A. Kinetics of a Rigid body in two and three dimensions
2. B. Energy and momentum methods for a rigid body
3. C. Eccentric Impact

IX. Vibrations (4 hours, lecture)

1. A. Vibrations without damping
2. B. Free vibrations of rigid bodies
3. C. Forced vibrations
4. D. Damped vibrations

Total Lecture Hours: 54
Total Laboratory Hours: 0
Total Hours: 54

PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. Primary Method of Evaluation (choose one):

2) Problem solving demonstrations (computational or non-computational)

B. Typical Assignment Using Primary Method of Evaluation

Three steel spheres of equal weight are suspended from the ceiling by cords of equal length which are spaced at a distance slightly greater than the diameter of the spheres. See the figure below. After being pulled back and released, sphere A hits sphere B, which then hits sphere C. Denoting by e the coefficient of restitution between the spheres and by VO the velocity of A just before it hits B, determine:

I. the velocities of A and B immediately after the collision,
II. the velocities of B and C immediately after the second collision,
III. Assuming now that n spheres are suspended from the ceiling and that the first sphere is pulled back and released as described above, determine the velocity of the last sphere after it is hit for the first time,
IV. Use the results of Part c to obtain the velocity of the last sphere when n = 5, and e = 0.9.

C. College-level Critical Thinking Assignments

Critical Thinking Assignment 1:

The three blocks shown below are identical. Block B and C are at rest when block B is hit by block A, which is moving with a velocity v_A of 3 ft/s. After the impact, which is assumed to be perfectly plastic (e = 0), the velocity of block A and B decrease due to friction, while block C picks up speed, until all three blocks are moving with the same velocity v. Knowing that the coefficient of kinetic friction mk = 0.20, determine:

I. the time required for the three blocks to reach the same velocity,
II. the total distance traveled by each block during that time.

Critical Thinking Assignment 2:

A gear reduction system consists of three gears A, B, and C. Gear A has a radius of 2 inches and rotates clockwise with a constant angular velocity w(A) = 600 rpm. Gear B has a radius of 4 inches that is interlocked with gear A, as well as a smaller gear with a radius of 2 inches. Gear C has a radius of 6 inches and is interlocked with the smaller gear of gear B. Determine (a) the angular velocities of gears B and C, (b) the accelerations of the points on gears B and C which are in contact.

D. Other Typical Assessment and Evaluation Methods

Class Performance, Embedded Questions, Homework Problems, Multiple Choice, Objective Exam, Performance Exams, Presentation, Quizzes, Reading Reports, Term or Other Papers, True/False, Written Homework

INSTRUCTIONAL METHODS

Demonstration, Discussion, Group Activities, Lecture

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

WORK OUTSIDE OF CLASS

Answer questions, Problem solving activity, Required reading, Skill practice, Study, Written work (such as essay/composition/report/analysis/research)

TEXTS AND MATERIALS

A. Up-to-date Representative Textbooks: (Please use the following format: Author, Title, Edition, Publisher, Year. If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".)

Beer, Ferdinand, Vector Mechanics for Engineers, 12th edition (ISBN 978-1-259-97730-5), McGraw-Hill Education, 2019

B. Alternative Textbooks: (Please use the following format: Author, Title, Edition, Publisher, Year. If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".)

C. Required Supplementary Readings

D. Other Required Materials

CONDITIONS OF ENROLLMENT

A. Requisites (Course Prerequisites and Corequisites) Skills needed without which a student would be highly unlikely to succeed.

Requisite: Prerequisite

Category: sequential

Requisite course:
ENGR 9 (Statics) - Background in Forces, vectors, moment in two and three dimensions (This course requires specific knowledge related to problem solving that is essential to successfully passing the course. If a person does not have this knowledge and the associated skills, either through previous work experience, they may not succeed in the course.)

Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).

1. Draw basic free body diagrams for solving problems with forces and moments. (Course Objective #2)

2. Solve problems involving principles of static and kinetic friction. (Course Objective #5)

3. Determine the resultants of distributed forces and centers of gravity. (Course Objective #7)

4. Convert a system of forces and moments to an equivalent system at another point of a body (Course Objective #4)

B. Requisite: (Non-Course Prerequisite and Corequisites) Skills needed without which a student would be highly unlikely to succeed.

Requisite:

Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under

each skill(s). if applicable

C. Recommended Preparations (Course) (Skills with which a student's ability to succeed will be strongly enhanced.)

Requisite course:

Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objectives under each skill(s).

D. Recommended Preparation (Non-Course) (Skills with which a student's ability to succeed will be strongly enhanced.)

Requisite:

Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). if applicable

E. Enrollment Limitations

Enrollment Limitations and Category:

Enrollment Limitations Impact:

Course Created by: Pavan Nagpal **Date:** 02/20/2021

Original Board Approval Date: 06/21/2021