COURSE OUTLINE : ENGR 230
D Credit – Degree Applicable
COURSE ID 010245
Cyclical Review: August 2020

COURSE DISCIPLINE : ENGR

COURSE NUMBER : 230

COURSE TITLE (FULL) : Dynamics

COURSE TITLE (SHORT) : Dynamics

CALIFORNIA STATE UNIVERSITY SYSTEM C-ID : ENGR 230 - Dynamics

CATALOG DESCRIPTION

ENGR 230 covers the fundamentals of kinematics and kinetics of particles and rigid bodies. Topics include: kinematics of particle motion; Newton's second law, work-energy and momentum methods; kinematics of planar motions of rigid bodies; work-energy and momentum principles for rigid body motion as well as an introduction to mechanical vibrations.

Total Lecture Units: 4.00

Total Laboratory Units: 0.00

Total Course Units: 4.00

Total Lecture Hours: 72.00

Total Laboratory Hours: 0.00

Total Laboratory Hours To Be Arranged: 0.00

Total Contact Hours: 72.00

Total Out-of-Class Hours: 144.00

Prerequisite: ENGR 152 or equivalent.

ENTRY STANDARDS

	Subject	Number	Title	Description	Include
1	ENGR	152	Engineering Mechanics - Statics	Apply the principles of mechanics - statics to practical engineering problems in the following areas: composition and resolution of co-planar and non-planar force systems, equilibrium of rigid bodies, distributed forces, forces in trusses, frames and cables, shear and bending moments in beams, moments of inertia of areas and bodies;	Yes
2	ENGR	152	Engineering Mechanics - Statics	analyze and determine mechanics - statics situations or problems in order to develop the most efficient solutions;	Yes
3	ENGR	152	Engineering Mechanics - Statics	convert practical or hypothetical mechanics - statics situations or problems into mathematical or graphic terms.	No
4				create a free body diagram (FBD), showing all external forces, reactions, constraints and moments for a problem;	Yes
5				apply the equilibrium conditions and solve statically determinant problems;	No
6				implement various techniques to calculate mechanical loads;	No
7				solve for unknown forces and moments acting on a rigid body under equilibrium conditions;	Yes
8				convert practical or hypothetical statics problems into mathematical or graphical terms.	No

EXIT STANDARDS

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;);

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 communicate legible engineering solutions to be understood by engineers both in and out of their specific disciplines.

STUDENT LEARNING OUTCOMES

1 sketch free-body diagrams and kinetic diagrams by isolating rigid bodies and vectorially solve two-dimensional and three-dimensional kinematics and dynamics problems;

2 apply Newton's second law to drive and analyze the equations of motion of a particle, a system of particles and a rigid body in motion;

3 employ the conservation of work and energy laws in mechanics to solve dynamics problems, as an alternative method to Newton's laws of motion.

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Rectilinear Motion • Position, velocity and acceleration • Determination of the motion of a particle • Uniform rectilinear motion • Uniformly accelerated rectilinear motion • Relative motion of several particles	6	0	6
2	Curvilinear Motion • Position vector, velocity and acceleration • Derivatives of vector functions • Rectangular components of velocity and acceleration • Motion relative to a frame in translation • Tangential and normal components • Radial and transverse components	8	0	8
3	Kinetics of Particles: Newton's Second Law of Motion • Newton's second law of motion • Linear momentum of a particle • Rate of change of linear momentum Systems of units • Equations of motion • Dynamic equilibrium • Angular momentum of a particle • Equations of motion • Newton's law or gravitation	8	0	8

4	Work and Energy • Work of a force • Kinetic energy of a particle • Power and efficiency • Potential energy • Conservation of energy	6	0	6
5	Impulse and Momentum • Principles of impulse and momentum • Impulsive motion	6	0	6
6	Impact • Direct impact • Oblique impact	6	0	6
7	Kinetics of Systems of Particles • Application of Newton's laws to the motion of a system of particles • Linear and angular momentum of a system of particles • Conservation of momentum for a system of particles • Kinetic energy of a system of particles • Work-energy principle • Principle of impulse and momentum for a system of particles	8	0	8
8	Kinematics of Rigid Bodies: Translation, Rotation and Plane Motion • Translation • Rotation about a fixed axis • General plane motion • Absolute and relative velocity in plane motion • Absolute and relative acceleration in plane motion	8	0	8

9	Kinetics of Plane Motion • Equations of motion for a rigid body • Angular momentum of a rigid body in plane motion • D'Alembert's principle • Principle of work and energy for a rigid body • Work of forces acting on a rigid body • Kinetic energy of a rigid body in plane motion • Systems of rigid bodies • Conservation of energy • Power • Impulse-momentum for rigid bodies • Conservation of angular momentum	8	0	8
10	Vibration • Simple harmonic motion • Simple pendulum • Free vibrations of rigid bodies • Forced vibrations	8	0	8
				72

OUT OF CLASS ASSIGNMENTS

1 homework (e.g. defining the position, velocity and acceleration of a particle in motion);
2 projects (e.g. calculation of the energy of two rigid bodies in collision and compare to a simple experiment with measurable results) or (e.g. calculation of the momentum of two colliding billiard balls by measuring mass and velocity).

METHODS OF EVALUATION

1 homework (e.g. calculation of conservation of energy);
2 quizzes;
3 midterm exams;
4 projects (e.g. instructor assessment of project presentations);
5 final exam.

METHODS OF INSTRUCTION

☑ Lecture
☐ Laboratory
☐ Studio
☑ Discussion
☑ Multimedia

- [ ] Tutorial
- [ ] Independent Study
- [x] Collaboratory Learning
- [x] Demonstration
- [ ] Field Activities (Trips)
- [ ] Guest Speakers
- [ ] Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
Vector Mechanics for Engineers Dynamics	Required	New York: McGrawHill	12	Print	Beer, Ferdinand P.	9781259977305	2020
Engineering Mechanics - Dynamics.	Required	Upper Saddle River: Pearson	14	Print	Hibbeler, Russell C.	0132911272	2016