GAVILAN COLLEGE
5055 Santa Teresa Blvd
Gilroy, CA 95023

# Course Outline

**COURSE:** ENGR 2 DIVISION: 20 ALSO LISTED AS:

TERM EFFECTIVE: Fall 2022 CURRICULUM APPROVAL DATE: 04/12/2022

SHORT TITLE: STATICS

LONG TITLE: Statics

| Units | Number of Weeks | Type | Contact Hours/Week | Total Contact Hours/Units |
|---|---|---|---|---|
| 3 | 18 | Lecture: | 2 | 36 / 2 Units of Lecture |
| | | Lab: | 3 | 54 / 1 Units of Lab |
| | | Other: | 0 | 0 |
| | | Total: | 5 | 90 |

| | |
|---|---|
| Out of Class Hrs: | 72.00 |
| Total Learning Hrs: | 162.00 |

**COURSE DESCRIPTION:**

Vector treatment of two- and three-dimensional force systems acting on particles and engineering structures in equilibrium. Topics include forces, moments, couples, resultants, equilibrium conditions, trusses, centroids, moment of inertia, beams, shear and moment diagrams, cables, virtual work and friction. Students will combine analytical skills and the use of a high- programming language to solve real-world statics problems. Previous experience with scientific programming is recommended but not necessary. PREREQUISITE: Mathematics 1B and Physics 4A with a grade of 'C' or better. (C-ID ENGR 130)

PREREQUISITES:

Mathematics 1B and Physics 4A with a grade of 'C' or better.

CREDIT STATUS: D - Credit - Degree Applicable

GRADING MODES

L - Standard Letter Grade

REPEATABILITY: N - Course may not be repeated

SCHEDULE TYPES:

02 - Lecture and/or discussion
03 - Lecture/Laboratory
04 - Laboratory/Studio/Activity
047 - Laboratory - LEH 0.7
05 - Hybrid
71 - Dist. Ed Internet Simultaneous
72 - Dist. Ed Internet Delayed
73 - Dist. Ed Internet Delayed LAB
737 - Dist. Ed Internet LAB-LEH 0.7

**STUDENT LEARNING OUTCOMES:**

By the end of this course, a student should:

1. Effectively communicate problem statements and solutions in a manner easily deciphered by engineers in and out of one's specific discipline.
2. Determine the forces that act on rigid bodies including external forces, weight, normal, distributed loads, friction and reactions at supports.
3. Calculate internal forces in members and create shear and bending moment diagrams for beams.
4. Perform vector analysis methods addressing forces acting on rigid bodies, trusses, frames, and machines.
5. Analyze two- and three-dimensional force systems on rigid bodies in static equilibrium.

**COURSE OBJECTIVES:**

By the end of this course, a student should:

1. Identify and apply the principles of Minimal Potential Energy and Virtual Work to the solution of quantitative problems.
2. Identify and apply the principles of frictional forces to the solution of quantitative problems.
3. Identify and apply the principles of beam theory to the solution of quantitative problems.
4. Identify the differences between trusses and frames/machines.
5. Apply the method of sections and the method of joints to solve for the equilibrium state of a truss.
6. Identify and apply the principles of centroids and moment of inertia to the solution of quantitative problems.
7. Identify and apply the principles of forces, moments and couples to the solution of quantitative problems.
8. Formulate and solve engineering problems.
9. Communicate legible problem solutions to be understood by engineers in and out of their specific discipline.
10. Determine the forces that act on rigid bodies including external forces, weight, normal, distributed loads, friction and reactions at supports.
11. Calculate internal forces in members and create shear and bending moment diagrams for beams
12. Analyze two- and three-dimensional force systems on rigid bodies in static equilibrium.
13. Perform vector analysis methods addressing forces acting on rigid bodies, trusses, frames, and machines.
14. Determine the force reactions at the supports of trusses and compute the forces in truss-members;

**COURSE CONTENT:**
Curriculum Approval Date: 04/12/2022
**LECTURE CONTENT:**
2 HOURS
1. Vector mathematical operations
addition, subtraction, negation
dot-product, cross-product
mixed triple product
2 HOURS
2. The Principle of static equilibrium: ?F = 0
Newton’s Law's of Motion
decomposition of force vectors into Cartesian components
unit vectors
4 HOURS
3. Statics of particles in two or three dimensions
space (dimensional) diagram
free body diagrams
internal vs. external forces
4 HOURS
4. Equivalent system of forces
moment of a force about a point or axis
moment of a force-couple
equivalent force systems: forces only, moments and forces
varignon’s theorem
4 HOURS
5. Statics of rigid bodies
constructing free-body diagrams
line-of-action and the principle of transmissibility
equilibrium of two-force and three-force bodies
force reactions at supports and connections in two and three dimensions
determinate and indeterminate reaction systems
support-reaction types
ball
rough surface roller
ball-and-socket
universal joint
fixed support
hinge and bearing
pin and bracket
2 HOURS
6. Distributed forces: centroids and centers of gravity
first moment of areas and lines
theorem of Pappus-Guldinus

**COURSE CONTENT(CONTINUED):**
**LECTURE CONTENT(CONTINUED):**
2 HOURS
7. Forces on Submerged Surfaces
hydrodstatic-pressure versus fluid-depth
free body diagrams for submerged bodies
center of pressure location using the first moment of areas
resultant of hydrostatic forces
4 HOURS
8. Analysis of structures
trusses: forces in members
method of joints;
method of sections
frames and machines: transmission and transformation of forces
2 HOURS
9. Forces in beams and cables
shear and bending-moment diagrams for point-loaded and distributed-loaded beams
cables with concentrated and distributed force-loads
2 HOURS
10. Friction
laws of dry friction
coefficient of sliding and static friction
angle of friction
friction forces: F = ?N
free-body diagrams that include friction forces
belt friction forces and the angle of wrap
2 HOURS
11. Moments of Inertia
second moment
radius of gyration
product of inertia
parallel-axis theorem
moments of inertia for composite areas/masses
4 HOURS
12. Energy Methods
Principle of Minimal Potential Energy
Virtual Work.
2 Hours
CONTENT: Final Exam
Total 36 hours.

**COURSE CONTENT(CONTINUED):**

**LAB CONTENT:**

During Lab hours we will follow the same topics covered in lecture but with the objective of combining problem-solving activities with programming activities. We will use as a lab manual the book: Solving Statics Problems in MATLAB to accompany Engineering Mechanics Statics by Meriam, Kraige and Halper.

3 HOURS

1. LAB: Using programming tools for vector mathematical operations.

addition, subtraction, negation

dot-product, cross-product

mixed triple product

3 HOURS

2. LAB: Using programming tools to solve problems involving the principle of static equilibrium: ?F = 0

Newton’s Law's of Motion

decomposition of force vectors into Cartesian components

unit vectors

6 HOURS

3. LAB: Using programming tools to solve problems involving statics of particles in two or three dimensions

space (dimensional) diagram

free body diagrams

internal vs. external forces

6 HOURS

4. LAB: Using programming tools to solve problems involving equivalent system of forces

moment of a force about a point or axis

moment of a force-couple

equivalent force systems: forces only, moments and forces

varignon’s theorem

6 HOURS

5. LAB: Using programming tools to solve problems involving statics of rigid bodies

constructing free-body diagrams

line-of-action and the principle of transmissibility

equilibrium of two-force and three-force bodies

force reactions at supports and connections in two and three dimensions

determinate and indeterminate reaction systems

support-reaction types

ball

rough surface roller

ball-and-socket

universal joint

fixed support

hinge and bearing

pin and bracket

3 HOURS

6. LAB: Using programming tools to solve problems involving distributed forces - centroids and centers of gravity

first moment of areas and lines

theorem of Pappus-Guldinus

**COURSE CONTENT(CONTINUED):**

**LAB CONTENT(CONTINUED):**

3 HOURS

7. LAB: Using programming tools to solve problems involving forces on Submerged Surfaces

hydrodstatic-pressure versus fluid-depth

free body diagrams for submerged bodies

center of pressure location using the first moment of areas

resultant of hydrostatic forces

3 HOURS

8. LAB: Using programming tools to solve problems involving analysis of structures

trusses: forces in members

method of joints;

method of sections

frames and machines: transmission and transformation of forces

3 HOURS

9. LAB: Using programming tools to solve problems involving forces in beams and cables

shear and bending-moment diagrams for point-loaded and distributed-loaded beams

cables with concentrated and distributed force-loads

3 HOURS

10. LAB: Using programming tools to solve problems involving friction

laws of dry friction

coefficient of sliding and static friction

angle of friction

friction forces: F = ?N

free-body diagrams that include friction forces

belt friction forces and the angle of wrap

3 HOURS

11. LAB: Using programming tools to solve problems involving Moments of Inertia

second moment

radius of gyration

product of inertia

parallel-axis theorem

moments of inertia for composite areas/masses

6 HOURS

12. LAB: Using programming tools to solve problems involving the Principle of Minimal Potential Energy and Virtual Work.

6 HOURS

13. LAB: Design and build a truss using CAD software and programming tools

Total 54 hours.

**METHODS OF INSTRUCTION:**

Instruction is by lecture, lab/discussion, demonstrations and/or illustration. Students are required to present problem solutions to their classmates. Students are required to do projects and activities using a high-level programming language such as Matlab or Octave. Students are also required to complete a Bridge (Truss) design Project and fabricate a wooden dowel bridge.

**OUT OF CLASS ASSIGNMENTS:**

Required Outside Hours 8

Assignment Description

A one time project that requires students to analyze and study pertinent text material, solved examples and lecture notes. In addition students will have to use computer software to build a truss.

Project: Truss Analysis using Matlab/Octave

Required Outside Hours 64

Assignment Description

Regularly assigned homework that requires students to apply the principles and skills covered in class by solving related problems.

**METHODS OF EVALUATION:**

Skill demonstrations

Evaluation Percent 20

Evaluation Description

Students will demonstrate the ability to use scientific computing and programming skills to solve static problems during lab/discussion hours.

Problem-solving assignments

Evaluation Percent 30

Evaluation Description

Homework Problems

Objective examinations

Evaluation Percent 50

Evaluation Description

Performance Exams

**REPRESENTATIVE TEXTBOOKS:**

Engineering Mechanics: Statics (15th Edition), Russell C. Hibbeler, Prentice Hall (Pearson), 2022.

ISBN: ISBN 13: 9780134798585

Rationale: The 14th Editions is the latest version of the book.

Reading level of text, Grade: 13 Grade Verified by: Verified by: DA using MS Word

Textbook to Supplement Lab Activities: Venkataraman, Panchapakesan, "Essential Mechanics - Statics and Strength of Materials with MATLAB and Octave" (2020). Open Access Books by RIT Staff and Faculty. 3. https://scholarworks.rit.edu/ritbooks/3

**RECOMMENDED MATERIALS:**

Lab Manual: Solving Statics Problems in MATLAB to accompany Engineering Mechanics Statics 6e (Wiley, 2006) by James L. Meriam, L. G. Kraige, Brian D. Harper

**ARTICULATION and CERTIFICATE INFORMATION**

CSU TRANSFER:

Transferable CSU

UC TRANSFER:

Transferable UC

**SUPPLEMENTAL DATA:**

Basic Skills: N
Classification: Y
Noncredit Category: Y
Cooperative Education:
Program Status: 1 Program Applicable
Special Class Status: N
CAN: ENGR8
CAN Sequence: XXXXXXXX
C-ID ENGR 130
Prior to College Level: Y
Non Credit Enhanced Funding: N
Funding Agency Code: Y
In-Service: N
Occupational Course: E
Course Control Number: CCC000180918
Sports/Physical Education Course: N
Taxonomy of Program: 090100
CIP: 140102