ENGR M16: ENGINEERING STATICS AND STRENGTH OF MATERIALS

Originator
srelle

College
Moorpark College

Discipline (CB01A)
ENGR - Engineering

Course Number (CB01B)
M16

Course Title (CB02)
Engineering Statics and Strength of Materials

Banner/Short Title
Engr Stat/Strength-Mat

Credit Type
Credit

Start Term
Spring 2020

Catalog Course Description
Examines the relationships which exist between two important branches of mechanics, namely, statics and strength of materials. Applies the principles of statics to the study of forces both external and internal to the body, moments and couples, responsible for maintaining a state of equilibrium. Uses the principles of strength to investigate the effects of external and internal loadings on the stability and deformation of the body. Analyzes two- and three-dimensional force systems including frictional forces, support reactions, and distributed forces with respect to rigid bodies, trusses, frames, machines, beams, shafts, and thin-walled pressure vessels. Incorporates concepts of centroids, area moments of inertia, stresses, strains, Mohr's Circle, shear and bending moment diagrams, ductile and brittle failure theories, and deformations associated with axial, torsional and flexural loadings. Surveys analysis of statically indeterminate axially loaded members.

Taxonomy of Programs (TOP) Code (CB03)
0924.00 - *Engineering Technology, General (requires Trigonometry)

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)
C - Clearly 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

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
70
Maximum Contact/In-Class Lecture Hours
70

Activity

Laboratory

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
70
Total Maximum Contact/In-Class Hours
70

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
140
Maximum Outside-of-Class Hours
140

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
210
Total Maximum Student Learning Hours
210

Minimum Units (CB07)
4
Maximum Units (CB06)
4

Prerequisites
PHYS M20A and PHYS M20AL and MATH M25B or concurrent enrollment in MATH M25B

Entrance Skills

Prerequisite Course Objectives
PHYS M20A-recognize, recall, and apply the equations that describe physical phenomena involving the mechanics of solids and fluids; analyze and solve physics problems of at least average complexity appropriate for the course.
PHYS M20A-demonstrate ability to analyze and solve physics problems of greater than average difficulty.
PHYS M20A-demonstrate ability to analyze, synthesize physics problems of reasonable complexity and evaluate and judge the results of the solutions to these problems.

Prerequisite Course Objectives
MATH M25B- apply the definite integral to solve problems involving area, volume, arc length, surface area, work, moments and centers of mass in the plane, fluid force, and other applications.
MATH M25B- select appropriate techniques for evaluating an indefinite integral; techniques include basic integration forms, change of variables, integration by parts, trigonometric identities, trigonometric substitutions, partial fractions, and estimation techniques.
MATH M25B- find the slope of the tangent line at a point on a curve given in parametric form.
MATH M25B- compute the arc length of a curve and the area of a surface of revolution for curves given in parametric form.
MATH M25B- sketch the graph of a polar equation.
MATH M25B-convert the equation of a curve given in polar form to rectangular form and vice versa.
MATH M25B- find the slope of the tangent line at a point on a curve given in polar form.
MATH M25B- find the area of a region bounded by a polar equation.
MATH M25B- find the arc length of a curve given in polar form.
PHYS M20A-recognize, recall, and apply the equations that describe physical phenomena involving the mechanics of solids and fluids; analyze and solve physics problems of at least average complexity appropriate for the course.
PHYS M20A-demonstrate ability to analyze and solve physics problems of greater than average difficulty.
PHYS M20A-demonstrate ability to analyze, synthesize physics problems of reasonable complexity and evaluate and judge the results of the solutions to these problems.
PHYS M20AL-assemble and perform experiments in the basic laws of the mechanics of solid and fluids.
PHYS M20AL-critically evaluate the experimental results and procedures using accepted values and other relevant information and draw conclusions regarding the efficacy of the experimental procedure.
PHYS M20AL-suggest practical applications for the values measured, conclusions reached, or methods utilized in the experiment.

Prerequisite Course Objectives

PHYS M20AL-assemble and perform experiments in the basic laws of the mechanics of solid and fluids.
PHYS M20AL-critically evaluate the experimental results and procedures using accepted values and other relevant information and draw conclusions regarding the efficacy of the experimental procedure.
PHYS M20AL-suggest practical applications for the values measured, conclusions reached, or methods utilized in the experiment.

Requisite Justification

Requisite Type
Prerequisite

Requisite
PHYS M20A

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Requisite Type
Prerequisite

Requisite
MATH M25B

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Requisite Type
Prerequisite

Requisite
PHYS M20AL

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Closely related lecture/laboratory course

Requisite Type
Concurrent

Requisite
MATH 25B

Requisite Description
Course not 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 appropriate knowledge of physics, engineering, and mathematics to explain, calculate and manipulate vector quantities such as resultant force and moment of a force about a point or an axis.
2	apply appropriate engineering problem solving techniques, including free body diagrams, identification of applicable laws of physics, and shear and bending moment diagrams to problems that involve statically determinate and indeterminate systems.
3	use geometric properties of bodies such as centroid and area moment of inertia appropriately to calculate resultant forces, moments, and internal loadings.
4	discuss and calculate mechanical properties related to stress-strain diagrams, and stress transformations using Mohr's circle for commonly used engineering materials.
5	in groups of 2 or 3 employ engineering problem solving techniques and the engineering design process to design, analyze, build, and present a truss bridge made out of Popsicle sticks.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	communicate effectively and legibly the formulation of solutions to engineering problems that can be understood by engineers within and outside of their specific disciplines.
2	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.
3	calculate internal forces and stresses in rigid bodies and create shear and bending moment diagrams for beams.
4	perform vector analysis to determine the net effect of forces, bending moments, and torques acting on rigid bodies, trusses, frames, machines, beams, and shafts.
5	analyze two- and three-dimensional force systems and moments acting on rigid bodies in static equilibrium.
6	analyze statically indeterminate systems using compatibility condition or the principle of superposition.
7	perform stress transformation using equilibrium methods and Mohr's circle.

Course Content

Lecture/Course Content

- **10% - Forces and Moments**
  - Coordinate systems: coordinate direction angles
  - Vector operations: dot and cross products, unit vectors, position vectors
  - Couples
  - Reduction of systems
- **20% - Equilibrium of Rigid Bodies**
  - Free-body diagrams
  - Two- and three-dimensional problems
  - Friction
- **20% - Structural Analysis**
  - Rigid bodies
  - Trusses
  - Machines
  - Frames
  - Joints and supports
- **5% - Geometrical Properties**
  - Center of gravity, center of mass, centroid
  - Moments of inertia
- **15% - Internal Loadings**
  - Stress and strain: Normal and shear
  - Distributed loads
  - Shear and moment diagrams
  - Combined loadings and pressure vessels
- **5% - Stress Transformation**
  - Transformation equations
  - Mohr's circle
- **3% - Transverse Shear**

- Shear formula
- Shear stress in beams

- **5% - Bending**
  - Flexure formula
  - Deformation of a straight member
  - Deflection and buckling
- **5% - Torsion**
  - Deformation of circular shafts
  - Angle of twist
  - Shear stress
- **5% - Axial Loads**
  - Saint-Venant's principle
  - Elastic deformation
  - Statically indeterminate systems
  - Thermal stress
- **7% - Mechanical Properties of Materials**
  - Tension and compression
  - Normal and shear stress-strain diagrams
  - Hooke's law
  - Poisson's ratio

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

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
Computational homework
Group projects
Objective exams
Problem-solving exams
Participation
Quizzes
Reports/papers
Skills demonstrations

Instructional Methodology

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

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

Describe specific examples of the methods the instructor will use:

Instructor will use PowerPoint presentation, class discussions, small group activity, and classroom demonstration to explain 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

- Write a technical report documenting the design and construction process of the Popsicle stick bridge project. Include a description of the problems encountered and the steps taken to solve them.
- Answer questions from lectures. An example would be: What does the centroid of a body represent? Under what conditions are the centroid, the center of mass, and the center of gravity considered to be coincident?

Critical Thinking Assignments

- Analyze problems and synthesize solutions to engineering problems using concepts of engineering mechanics (statics and strength of materials) and critically evaluate the results. An example would be: Two designs of a wide-flange I-beam are to be considered. In one design, the flange width and thickness are 200mm and 15mm, respectively, while the web thickness and depth are 30mm and 300mm, respectively. In the other design, the flange width and thickness are 200mm and 30mm, respectively, while the web thickness and depth are 15mm and 300mm, respectively. Which design will support a bending moment of 150 kN.m with the least amount of bending stress? What would be that stress?
- Apply knowledge of physics, mathematics, and engineering to derive formulas used in statics and strength of materials. An example would be: When an external torque is applied to a shaft it creates a corresponding internal torque within the shaft. Develop an equation that relates this internal torque to the shear stress distribution on the cross section of a circular shaft.

Reading Assignments

- Read handouts provided by the instructor regarding the rules, expectations, and constraints of the Popsicle stick bridge design project, including the technical writing guidelines.
- 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 Moments and Force Systems then, using the lecture notes provided by the instructor, determine the moment produced by the force**F**= {-20**i**+ 10**j**+ 15**k**} about the segment of the pipe assembly that is lying in the x-y plane as depicted in the diagram. Be sure to include units with your answer.

Skills Demonstrations

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

Outside Assignments

Representative Outside Assignments

- Homework that consists of statics and strength of materials problems that correspond to the lecture topics in class. For each topic listed in the course content section, the assignment will include at least ten problems, one of which will be of greater than average difficulty which may require analysis tools beyond the textbook. An example would be: Using numerical procedures, locate the centroid of an area defined by a mathematical function.
- Design projects which may include library and/or Internet research, equilibrium analysis and computations of force, moment, stress, strain, and deformation. An example would be: Design, analyze, and construct a simply supported bridge made entirely of Popsicle sticks and all-purpose white non-toxic glue.

Articulation

C-ID Descriptor Number

ENGR 130

Status

Conditionally approved

Expiration Date

2/2020

Additional C-ID Descriptor(s)

C-ID Descriptor(s)	Status
ENGR 240	

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Chico	CIVL 211	Statics	3
Cal Poly SLO	CE 204	Mechanics of Materials I	3

UC Santa Barbara	ME 14	Statics	4
UC Irvine	ENGRMAE/ENGR/ ENGRCEE 30	Statics	4
UC Davis	ENGIN 35	Statics	4
San Diego State Univ.	A E/ M E 200	Statics	3
CSU Northridge	CE 240	Engineering Statics	3
UC Los Angeles	MECH7AE 96	Statics and Dynamics	4

Comparable Courses within the VCCCD
ENGR V12 - Engineering Statics

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:
Fall 1995

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

Description
Hibbeler, R.C. (2016).*Statics and mechanics of materials,*(5th ed.). Prentice Hall.

Resource Type
Textbook

Classic Textbook
No

Description
Beer, F.P., Russell, J.E., DeWolf, J.T., and Mazurek, D. (2016). *Statics and mechanics of materials*, (2nd ed.). McGraw-Hill Education.

Resource Type
Textbook

Classic Textbook
No

Description
Bedford, A., Fowler, W., and Liechti, K.M. (2003). *Statics and mechanics of materials*. Prentice Hall.

Resource Type
Textbook

Classic Textbook
No

Description
Goodno, B.J., and Gere, J. (2018).*Statics and mechanics of materials*, (SI ed.). Cengage Learning.

Library Resources

Assignments requiring library resources
Design projects

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources

Research, using the Library's print and online resources, to gather relevant information for the design, construction, and force analysis of the required bridge design project.

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 statics or strength of materials 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 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
09/28/2019

Dean
09/29/2019

Technical Review
10/03/2019

Curriculum Committee
10/15/2019

DTRW-I
MM/DD/YYYY

Curriculum Committee
MM/DD/YYYY

Board
MM/DD/YYYY

CCCCO
10/18/2019

Control Number
CCC000433874

DOE/accreditation approval date
MM/DD/YYYY