



COURSE OUTLINE : ENGR 241
D Credit – Degree Applicable
COURSE ID 010244
Cyclical Review: August 2020

COURSE DISCIPLINE : ENGR

COURSE NUMBER : 241

COURSE TITLE (FULL) : Strength of Materials

COURSE TITLE (SHORT) : Strength of Materials

CALIFORNIA STATE UNIVERSITY SYSTEM C-ID : ENGR 240 – Strength of Materials

CATALOG DESCRIPTION

ENGR 241 is the application of mechanics to determine the effect of forces and torques on materials. Students apply this knowledge to the design of load bearing components. The course covers the following topics: stress, strain, axial loading, torsion, flexural stresses, transverse shear stress, horizontal shear stresses, stress transformations, Mohr's circle, thin-walled pressure vessels, ductile and brittle failure theories, shear and bending moment diagrams, stresses in a beam, methods of superposition, and elastic strain energy. Statically indeterminate systems are studied using Castigliano's theorem.

Total Lecture Units: 4.00

Total Laboratory Units: 0.00

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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.



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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;	Yes
4				create a free body diagram (FBD), showing all external forces, reactions, constraints and moments;	Yes
5				apply the equilibrium conditions and solve statically determinant problems;	Yes
6				implement various techniques to calculate and create 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 Determine the forces and moments (torques) applied on each structural member for a structural system;
- 2 determine the internal forces and couples at internal sections on each structural member for a structural system;
- 3 identify the applicable theory, and apply the appropriate equations to calculate the internal stresses, strains and /or displacements for loaded structural members;
- 4 use shear and moment diagrams to identify locations of maximum stress;
- 5 perform coordinate transformation of the state of stress and strain at a point, including using Mohr's Circle;
- 6 determine if a structural system meets its design specifications, and/or determine how he system will fail, given or having calculated the stresses, strains and displacements.



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STUDENT LEARNING OUTCOMES

- 1 create shear and moment diagrams and demonstrate their use in determining the location of maximum shear stress and bending moment on a beam;
- 2 analyze plane stress transformations by calculating principal stresses;
- 3 create and use Mohr’s circle to determine the maximum plane stress;
- 4 demonstrate the energy method of calculating strain energies.

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Introduction to Strength of Materials <ul style="list-style-type: none"> • Applications of stress analysis • Review of statics • Equilibrium • Factor of Safety in engineering design 	7	0	7
2	Stress and Strain <ul style="list-style-type: none"> • Normal stress/strain curves, Young’s modulus, Poisson’s ratio, energy density • Shear stress/strain curves, shear modulus, shear energy density • Plane stress and plane strain • General 3-D stress-strain relationships (optional) 	7	0	7
3	Axial Members <ul style="list-style-type: none"> • Members with constant internal force/area/material • Members with varying (discontinuous/continuous) internal force/area • Displacement methods to determine movement of a point • Energy methods • Statically indeterminate systems (optional) 	7	0	7
4	Torsion Members <ul style="list-style-type: none"> • Members with constant internal force/area/material • Members with varying (discontinuous/continuous) internal force/area • Displacement methods to determine movement of a point • Statically indeterminate systems (optional) 	7	0	7



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5	Beams <ul style="list-style-type: none"> • Shear and moment diagrams • Bending stress • Beam displacement • Shear stress • Shear flow • Shear center (optional) • Statically indeterminate systems (optional) 	7	0	7
6	Combined Loads and Stresses <ul style="list-style-type: none"> • Thin-walled pressure vessels • Combined loading • State of stress • Industry standards for pressure vessel design 	7	0	7
7	Stress Transformation <ul style="list-style-type: none"> • Transformation equations • Principal stresses/maximum shear stress • Mohr's circle • Strain transformation (optional) • Stresses in thin-walled pressure vessels • Using Mohr's circle in design 	8	0	8
8	Failure Criteria <ul style="list-style-type: none"> • Brittle failure (maximum normal stress) • Maximum shear stress (Tresca) • Maximum strain energy (von Mises) 	7	0	7
9	Buckling of Columns <ul style="list-style-type: none"> • Stability of structures • Euler's formula for pin-ended columns • Extension of Euler's formula to columns with other end conditions • Design of columns under centric and eccentric loads 	7	0	7



10	Energy Methods <ul style="list-style-type: none"> • Strain energy • Strain energy density • Elastic strain energy for normal stress • Elastic strain energy for shear stress • Impact loading • Design for impact loading • Work and energy under single load • Deflection under a single load by the work-energy method • Castigliano’s theorem • Deflections by Castigliano’s theorem • Statically indeterminate structures 	8	0	8
				72

OUT OF CLASS ASSIGNMENTS

- 1 homework (e.g. calculation of bending stress on a member underload);
- 2 projects (e.g. calculate the stress and strain of a common I-Beam and compare to a simple experiment by measuring deflection) or (e.g. create a Mohr’s circle diagram to demonstrate principal stresses).

METHODS OF EVALUATION

- 1 quizzes;
- 2 examinations;
- 3 projects (e.g. instructor assessment of projects).
- 4 final exam.

METHODS OF INSTRUCTION

- Lecture
- Laboratory
- Studio
- Discussion
- Multimedia
- Tutorial
- Independent Study
- Collaboratory Learning
- Demonstration
- Field Activities (Trips)



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Guest Speakers

Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
Mechanics of Materials	Required	New York, McGraw-Hill	8		Beer, Ferdinand P	978126011 3273	2020
Mechanics of Materials	Required	Upper Saddle River: Pearson	10		Hibbeler, Russell. C.	978013431 9650	2017