



Engineering Bridge Program



ENGR 291 – Solid Mechanics & Dynamics

Course: ENGR 291 Solid Mechanics & Dynamics, 2018
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Textbook & References

No textbook required for ENGR 291.

Calendar Description

In this course, the topics will cover differential equations applied to solid mechanics and dynamics. In addition to the detailed objectives, an overall objective of ENGR 291 is to integrate the concepts from different subjects to work effectively on multi-disciplinary engineering problems.

Intended Learning Outcomes

Upon successful completion of this course a student will be able to:

- Describe 2-D motion of rigid bodies, and compute velocities and accelerations of any point on a rigid body.
- Determine the inertial (d'Alembert) forces and moments of a rigid body.
- Calculate applied forces and moments, to balance inertial forces and moments for a rigid body.
- Determine the kinematic and kinetic (motion, force and moment) values for a moving body from momentum and energy relationships (and vice-versa).
- Model and analyze the vibration of a one-dimensional system.
- Apply the fundamental concepts in Solid Mechanics:
 - equilibrium, compatibility and material behaviour;
 - normal, shear and bearing stress;
 - stress concentration;
 - stress on an oblique plane; and
 - factor of safety.
- Describe multi-axial stresses and strains, Hooke's Law, Poisson's ratio, St. Venant's principle; volumetric strain, and bulk modulus. Analyze thin-walled pressure vessels.
- Transform stress and strain axes in two dimensions using Mohr's Circle and describe the concept of principle stresses.
- Analyze deformation, shear stress, elastic response, and angle of twist on circular shafts.
- Analyze indeterminate shafts.
- Determine the deformation, stress, and moment of inertia for beams in bending and apply the fundamental beam formula.
- Construct shear force and bending moment diagrams for transverse loading. Apply the elastic curve, direct integration method, singularity functions, superposition, and tabulated solutions.

Course Content (subject to modification, if necessary)

Week	Assignments	Course Content
1	-	Dynamics – Rigid body kinematics, relative positions and velocities.
2	-	Dynamics – Relative accelerations of a rigid body.
3	Assign. 1	Dynamics – Rigid body kinetics, forces, moments, d’Alembert’s principle.
4	-	Dynamics – Rigid body kinetics using energy methods.
5	-	Dynamics – Vibration of single degree-of-freedom systems.
6	-	READING BREAK
7	Assign. 2	Dynamics – Review period, TERM Exam 1.
8	-	Solid Mechanics – Cartesian tensor notation, the stress tensor, normal and shearing stresses, the stress equilibrium equations, stress concentration factors, factors of safety.
9	-	Solid Mechanics – The strain tensor, compatibility equations, volumetric strain, Poisson’s ratio, constitutive equations and Hooke’s Law, St. Venant’s principle.
10	Assign. 3	Solid Mechanics – Stress and strain transformations, principle stresses as eigenvalues, 2D Mohr’s circle, thin-walled pressure vessels.
11	-	Solid Mechanics – Bernoulli-Euler beam theory, second-moment of area and the flexure formula, load, shear, moment, slope, and deflection curves, singularity functions.
12	Assign. 4	Solid Mechanics – Beam analysis using direct integration and singularity functions.
13	Assign. 5	Solid Mechanics – Stress analysis and deformations of circular shafts, angle of twist, statically indeterminate shafts.
14	-	Solid Mechanics – Review period, TERM Exam 2.

Evaluation & Grading System

Assignments	20% (graded on completion with complete solutions posted)
Term Exam 1	40% (calculator & crib sheet allowed, closed book)
Term Exam 2	40% (calculator & crib sheet allowed, closed book)

NOTE: As per College policy, you must pass both term exams to pass ENGR 291

A+	90-100	B-	70-72
A	85-89	C+	65-69
A-	80-84	C	60-64
B+	77-80	D	50-59
B	73-76	F	<50