Course Number and Title: CET 270 Solid Mechanics with Calculus

Campus Location:
Georgetown, Stanton

Effective Date:
2018-52

Prerequisite:
ENG 101, CET 258

Co-Requisites:
none

Course Credits and Hours:
3.00 credits
3.00 lecture hours/week
1.00 lab hours/week

Course Description:
The course covers topics including the concepts of stress and strain, plane stress, transformation of stress and strain, Mohr's circle, material properties, and stress-strain relationships. This course provides determination of stresses and displacements in axially loaded members and pressure vessels, stresses and displacements in round bars subject to torsion, impact, and dynamic loads. The basic mechanics for the design and analysis of simple structures, and mechanics of deformable bodies is included.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
None

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Determine force and moment generated internal reactions together with the resulting tensile, compressive, shear, and bearing stresses for systems under various axial loading configurations. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
2. Calculate various design parameters for mechanical systems using the principles of safety factors, allowable stress, applied loading, and stress concentration factors.(CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
3. Calculate the resulting strain, deformation, modulus of elasticity and thermal stresses and strains for mechanical systems under various axial loading configurations and temperature conditions. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
4. Correctly perform a complete tensile test on various specimens determining all appropriate material characteristics. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
5. Determine the torsional shear stress, angular deformation, transmitted torque, power, revolutions per minute (rpm), and required size for solid and hollow circular shafts under torsional loads. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
6. Correctly perform a complete torsion test on various specimens determining all appropriate material characteristics. (CCC 1, 2, 3, 4 ,5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
7. Calculate the resulting shear stress and bending moment at any point along a loaded beam, and compile this data into shear-moment diagrams using both analytical techniques and the analysis of standard beam tables. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
8. Determine the tensile and compressive bending stresses, horizontal shear stresses, and calculate the most economical size and cross-section for beams under various loading configurations using both analytical techniques and the analysis of standard beam tables. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
9. Calculate the critical load, stress, slenderness ratio, required size, length, and cross-section for columns with various support modes. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
10. Use computer software to solve for various stresses on beams, shafts, columns, and structures. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
11. Design and conduct laboratory experiments on the behavior of civil engineering materials, including steel, aluminum, concrete, and timber. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 2, 3, 4; CTO 1, 2, 3)
12. Demonstrate professional and ethical conduct as expected in industry. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 4, 5; CTO 1, 2, 4)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency

they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Determine force and moment generated internal reactions together with the resulting tensile, compressive, shear and bearing stresses for systems under various axial loading configurations.
    1. Correctly define the following terms: *allowable stress, bearing stress, compression, compressive stress, safety stress, shear, shear stress, tensile stress,* and *tension*.
    2. Determine the internal reactions, forces, and moments at various sections when given a body or system acted upon various force configurations.
    3. Determine tensile, compressive, shear and bearing stress as appropriate when given a body or system acted upon by various force configurations.
2. Calculate various design parameters for mechanical systems using the principles of safety factors, allowable stress, applied loading, and stress concentration factors.
    1. Solve problems relating to safety factor, allowable stress, applied loading, and design calculations.
    2. Determine the maximum stress on various members with different types of stress risers with given data on stress concentration factors.
3. Calculate the resulting strain, deformation, modulus of elasticity, and thermal stresses and strains for mechanical systems under various axial loading configurations and temperature conditions.
    1. Define the following terms: *% area reduction, % elongation, Brittleness, deformation, Ductility, elastic limit, elastic region, extensometer, gage length, Hooke's Law, lateral strain, longitudinal strain, modulus of elasticity, plastic region, Poisson's Ratio, proportional limit, strain, thermal expansion, ultimate strength,* and *yield point.*
    2. Determine the resulting deformation, strain, and modulus of elasticity with given data on a body or system acted on by various force configurations.
    3. Calculate the resulting thermal stress, deformation, and strain under various temperature conditions.
4. Correctly perform a complete tensile test on various specimens determining all appropriate material characteristics.
    1. Plot the stress-strain curve for the material, and determine all appropriate strength characteristics given a set of tensile test data for a particular specimen.
    2. Correctly perform a complete tensile test on various specimens determining all appropriate material characteristics.
5. Determine the torsional shear stress, angular deformation, transmitted torque, power, revolutions per minute (rpm), and required size for solid and hollow circular shafts under torsional loads.
    1. Define the following terms: *Hooke's Law for shear, isotropic material, modulus of rigidity, torsion test, torsional deformation,* and *troptometer*.
    2. Determine the angular deformation in circular shafts subjected to torsional load.
    3. Calculate the shear stress in solid and hollow circular shafts subjected to torsional loads.
    4. Calculate transmitted torque and power, rpm, angular deformation, and required size for solid and hollow shafts and coupling components given appropriate design and power transmission data.
6. Correctly perform a complete torsion test on various specimens determining all appropriate material characteristics.
    1. Plot the torsional stress-strain curve for the material, and determine all appropriate strength characteristics given a set of torsion test data for a particular specimen.
    2. Correctly perform a complete torsion test on various specimens determining all appropriate material characteristics.
7. Calculate the resulting shear stress and bending moment at any point along a loaded beam, and compile this data into shear-moment diagrams using both analytical techniques and the analysis of standard beam tables.
    1. Define the following terms: *bending moment, cantilever beam, continuous beam, fixed beam, shear force, simple beam, statically determinate,* and *statically indeterminate.*
    2. Calculate the shearing force and bending moment at any point along a beam.
    3. Draw shear-moment diagrams for statically determinate beams.
    4. Correctly analyze and apply data from a set of standard beam tables.
    5. Discuss shear stress and shear flow in laterally loaded beams.
    6. Analyze indeterminate axial and indeterminate torsional problems.
8. Determine the tensile and compressive bending stresses, horizontal shear stresses, and calculate the most economical size and cross-section for beams under various loading configurations using both analytical techniques and the analysis of standard beam tables.
    1. Determine the tensile and compressive stresses in beams subjected to bending.
    2. Determine the horizontal shear stress in beams subjected to bending.
    3. Calculate the most economical size and cross section for beams based on strength criteria.
    4. Calculate the maximum deflection of beams with various loads, supports, and cross-sections using standard beam tables.
    5. Assess the allowable deflections and interpret the various acceptable beam sizes and cross-sections.
    6. Discuss flexural members consisting of two materials.
9. Calculate the critical load, stress, slenderness ratio, required size, length, and cross-section for columns with various support modes.
    1. Calculate the critical or Euler load, stress, and slenderness ratio for various column configurations.
    2. Determine the allowable load and stress for various column configurations.
    3. Calculate various design parameters for columns, including size, length, cross- section, and slenderness ratio.
10. Use computer software to solve for various stresses on beams, shafts, columns, and structures.
    1. Integrate computer applications for tensile and shear stress calculations.
    2. Interpret computer applications for shear force calculations.
    3. Employ computer applications for beam design calculations.
    4. Use computer applications for column compression calculations.

11. Design and conduct laboratory experiments on the behavior of civil engineering materials, including steel, aluminum, concrete, and timber.
    1. Apply tensile tests on known materials.
    2. Conduct tensile tests on unknown material.
    3. Integrate torsion tests on circular and hollow cross-sections.
    4. Employ bending stress/deflection analysis on beams.
12. Demonstrate professional and ethical conduct as expected in industry.
    1. Identify the need for self-discipline and time management in technical industries.
    2. Communicate and function effectively as a member of a team.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	**–**	**100**	**=**	**A**
83	**–**	**91**	**=**	**B**
75	**–**	**82**	**=**	**C**
0	**–**	**74**	**=**	**F**

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
Exam 1 (Summative)	15%
Exam 2 (Summative)	15%
Exam 3 (Summative)	15%
Group Design Projects/ Laboratory Experiments (Summative)	25%
Assignments (Formative)	30%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):
CETAASCET:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering activities, including but not limited to site development, hydraulics and hydrology, grading, and structural systems.
2. Conduct standardized field and laboratory testing on civil engineering project materials.
3. Select appropriate materials and estimate material quantities for technical projects.
4. Use graphic techniques and productivity software to produce engineering documents.
5. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.

CETAASCTO:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering activities, including but not limited to site development, hydraulics and hydrology, grading, and structural systems.
2. Use graphic techniques and productivity software to produce engineering documents.
3. Apply fundamentals of science and mathematics to solve engineering problems.
4. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.