Course Number and Title: MET 242 Strength of Materials

Campus Location:
Georgetown, Stanton

Effective Date:
2018-51

Prerequisite:
MET 132

Co-Requisites:
None

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

Course Description:
This course analyzes axial, shearing, and torsional stresses and strains in machine and structural elements such as beams, columns, and shafts under static, impact, and dynamic loads. Topics include thin-walled cylinders, joints, and couplings as well as shear and bending moment diagrams and the design of beams.

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 internal reactions together with the resulting tensile, compressive, shear, and bearing stresses for systems under various axial loading configurations. (CCC 2, 6; PGC MET 1, 6; DEM 1, 2, 3, 4, 5, 6, 9, 12)
2. Calculate various design parameters for mechanical systems using the principles of safety factors, allowable stress, applied loading, and stress concentration factors. (CCC 2, 5, 6; PGC MET 1, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
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 2, 6; PGC MET 1, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
4. Correctly perform a complete tensile test on various specimens, determining all appropriate material characteristics. (CCC 1, 2, 3, 6; PGC MET 1, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
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 2, 6; PGC MET 1, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
6. Correctly perform a complete torsion test on various specimens determining all appropriate material characteristics. (CCC 1, 2, 3, 6; PGC MET 1, 3, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
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 2, 5, 6; PGC MET 1, 6; DEM 1, 2, 3, 4, 5, 6, 9, 12)
8. Determine the tensile and compressive bending stresses and 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 2, 5, 6; PGC MET 1, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)
9. Calculate the critical load, stress, slenderness ratio, required size, length, and cross-section for columns with various support modes. (CCC 2, 6; PGC MET 2, 6, 7; DEM 1, 2, 3, 4, 5, 6, 9, 12)
10. Use MDSolids Computer Software to solve for various stresses on beams, shafts, columns, and structures. (CCC 1, 2, 6; PGC MET 1, 3, 6, 8; DEM 1, 2, 3, 4, 5, 6, 9, 12)

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 internal reactions together with the resulting tensile, compressive, shear, and bearing stresses for systems under various axial loading configurations.
    1. Correctly describe and/or define the following terms: tension, tensile stress, compression, compressive stress, shear, shear stress, bearing stress, safety stress, and allowable stress.
    2. Determine the internal reactions (forces and moments) at various sections given a body or system acted upon various force configurations.
    3. Determine the resulting tensile, compressive, shear, and bearing stress as appropriate 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 given appropriate information.
    2. Determine the maximum stress on various members with different types of stress risers given appropriate 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: *ductility*, *deformation*, *gage length*, *extensometer*, *proportional limit*, *elastic limit*, *ultimate strength*, *thermal expansion*, *elastic region*, *plastic region*, *modulus of elasticity*, *yield point*, *Hooke's law*, *brittleness*, *lateral strain*, *Poisson's ratio*, *longitudinal strain*, *strain*, *percent area reduction*, and *percent elongation*.
    2. Determine the resulting deformation, strain, and modulus of elasticity given 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*, *modulus of rigidity*, *isotropic material*, *torsional deformation*, *troptometer*, and *torsion test*.
    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. Compare results of tension test to a material's standard specifications.
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: *shear force*, *bending moment*, *simple beam*, *cantilever beam*, *fixed beam*, *continuous 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.
8. Determine the tensile and compressive bending stresses and 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. Determine various acceptable beam sizes and cross-sections given allowable deflections.
9. Calculate the critical load, stress, slenderness ratio and 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 MDSolids Computer Software to solve for various stresses on beams, shafts, columns, and structures.
    1. Use MDSolids computer applications for tensile and shear stress calculations.
    2. Use MDSolids computer applications for shear force calculations.
    3. Use MDSolids computer applications for beam design calculations.
    4. Use MDSolids computer applications for column compression calculations.

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.

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):
METAASMET

1. Use effective problem-solving skills and make appropriate decisions relative to the technical field.
2. Design basic mechanical systems with the use of computer-aided drafting equipment.
3. Demonstrate basic computer literacy and knowledge of computer software applications in both the business and technical fields.
4. Use hand and power tools for standard manufacturing operations.
5. Conduct basic machining and welding operations; and perform basic programming of computer/numerically-controlled machines.
6. Calculate forces, properly size structures and mechanical components, and perform standard materials testing procedures.
7. Demonstrate an understanding of basic AC and DC electrical control circuits.
8. Select appropriate materials for basic mechanical applications.
9. Review and/or design basic hydraulic/pneumatic power systems.
10. Select basic machine components for mechanical systems.
11. Exhibit professional traits, including the ability to work with minimal supervision, willingness to learn new skills and contributing to team project efforts.

DETAASDEM

1. Apply the knowledge, techniques, skills, and modern tools of the discipline to narrowly defined engineering technology activities.
2. Apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require limited application of principles but extensive practical knowledge.
3. Conduct standard tests and measurements, and to conduct, analyze, and interpret experiments.
4. Function effectively as a member of a technical team.
5. Identify, analyze, and solve narrowly defined engineering technology problems.
6. Apply written, oral, and graphical communication in both technical and nontechnical environments; and identify and use appropriate technical literature.
7. Recognize the need for and an ability to engage in self-directed continuing professional development.
8. Integrate a commitment to address professional and ethical responsibilities, including a respect for diversity.
9. Demonstrate a commitment to quality, timeliness, and continuous improvement.
10. Demonstrate knowledge and technical competency in engineering materials, applied mechanics, and manufacturing methods.
11. Demonstrate knowledge and in-depth technical competency in applied drafting practice emphasizing mechanical components and systems, as well as fundamentals of descriptive geometry, orthographic projection, sectioning, tolerancing and dimensioning, and computer aided drafting and design.
12. Demonstrate knowledge and technical competency in the in-depth application of physics having emphasis in mechanical components and design.

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.