MEG 741
Energy and Variational Methods in Applied Mechanics
Fall 2016

Time:
Office Hours:
Text: "Mechanics of Structures: Variational and Computational Methods," Walter D. Pilkey and Walter Wunderlich, Second Edition, CRC Press, 2003.

Grades Distribution:

HW	20 %
Exams	80 %

Grading:
100 - 90:A / 90-80:B / 80-65:C / 65-50:D

Course Purpose:

- This course builds on the principles laid in the Mechanics of Materials undergraduate course. The theories of mechanics of elastic bodies will be explained in more details.
- Energy methods, which presents a tool for deriving the equations of motion of elastic objects, will be emphasized.
- The course will cover numerical methods to solve these equations also.
- Students should be familiar with using MATLAB or similar tools.

Learning Outcomes:
By the end of this course, you should be able to:

i. Understand the formulation of the linear problem of elasticity and provide a solution from simple problems
ii. Formulate problems using the principles of virtual work and variational principles of elasticity
iii. Understand the basic principles of the finite element method (FEM)
iv. Develop equations for vibration of simple structures
v. Write computer codes to analyze mechanical systems

Course Policies:

Homework:

- Homework is due week after it is assigned unless otherwise specified.
- Several problems will be assigned at the end of each chapter. Additional problems that are not in the textbook may be also assigned.
- The objective of the homework is to *train* you to use the principles we covered in class. Please feel free to solve homework in groups or individually.
- Depending on the nature of the homework, please submit your assignments on 8.5" x 11" paper or email them. Be sure to include your name at the top of the first page. Staple your pages together. Include the following information for each problem:
  - *Most of the problems will require a sketch of the problem along with one or more Free Body Diagrams showing the applied loads along with the external and internal reactions.*
  - *Show all of your work. Make reference to equations in the book if you do not want to repeat them.*
  - *You will not receive credit for a correct answer if you have not shown the work*.
- Students are encouraged to attempt to solve more problems to increase the depth of their understanding of the material.
- Many of the homework assignments will be in the form of proofs and derivations. I suggest using MuPad for derivations and proofs. MuPad is a part of MATLAB, which has the symbolic package in a presentable.
- There will be programming assignments. You can choose whatever language you prefer for programming. I will be showing you examples in MATLAB.

Exams:

- You will receive a notice of the exam time at least one week before it.
- Exams are in-class (open book) or take-home.
- The objective of exams is to test your understanding of material covered so far. Therefore, please do not expect to see one of the homework problems, slightly masked, in the test. You should not also expect to see something very new in an exam, as you will not have enough time to consider it.
- My experience tells me that your chance of passing an exam is greatly enhanced if you solve homework regularly.

Syllabus:

T 8/30	Introduction	
Th 9/1	General Theory of Elasticity	(Chapter 1)
T 9/6	General Theory of Elasticity	(Chapter 1)
Th 9/8	Simplified Equations	(Chapter 1)
T 9/13	Simplified Equations	(Chapter 1)
Th 9/15	**Exam #1**	
T 9/20	Principle of Virtual Work	(Chapter 2)
Th 9/22	Principle of Virtual Work	(Chapter 2)
T 9/20	Strain Energy	(Chapter 2)
Th 9/22	**Exam #2**	
T 9/27	Approximate Methods (Ritz)	
Th 9/29	Application to Slender Bars	(Chapter 7)
T 10/4	Application to Slender Bars	(Chapter 7)
Th 10/6	Application to Slender Bars	(Chapter 7)
T 10/11	Introduction to FEM. Trusses	(Chapter 4)
Th 10/13	General Equations of FEM. Axially Loaded Bars	(Chapter 4)
T 10/18	Beam Applications	(Chapter 5)
Th 10/20	Beam Applications	(Chapter 5)
T 10/25	Beam Applications	(Chapter 5)
Th 10/27	Isoparametric Elements	(Chapter 6)
T 11/1	Plate Applications	(Chapter 6)
Th 11/3	**Exam #3**	
T 11/8	Buckling of Slender Bars	(Chapter 11)
Th 11/10	Buckling of Slender Bars	(Chapter 11)
T 11/15	Buckling of Plates	(Chapter 11)
Th 11/17	Dynamics of General Elastic Solids	(Chapter 10)
T 11/22	Slender Bar Vibrations: Differential Equation Method	(Chapter 10)
Th 11/24	**Thanksgiving Break (no class)**	
T 11/29	Slender Bar Vibrations: Differential Equation Method	(Chapter 10)
Th 12/1	Work and Energy Methods in Beam Bending Vibration	(Chapter 10)
T 12/6	Work and Energy Methods in Beam Bending Vibration	(Chapter 10)
Th 12/8	Work and Energy Methods in Beam Bending Vibration	(Chapter 10)
T 12/13	**FINAL EXAM (1;00-3:00 PM)**	

Library Resources

- Students may consult with a librarian on research needs. For this class, the subject librarian is Sue Wainscott. (https://www.library.unlv.edu/contact/librarians_by_subject). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at https://www.library.unlv.edu.

Policies:

Academic Misconduct—Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: https://www.unlv.edu/studentconduct/student-conduct.

Copyright—The University requires all members of the University Community to familiarize themselves **with** and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: http://www.unlv.edu/provost/copyright.

Disability Resource Center (DRC)—The UNLV Disability Resource Center (SSC-A 143, http://drc.unlv.edu/, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Religious Holidays Policy—Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor within the first 14 calendar days of the course for fall and spring courses (excepting modular

courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: http://catalog.unlv.edu/content.php?catoid=6&navoid=531.

Transparency in Learning and Teaching—The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:

https://www.unlv.edu/provost/teachingandlearning
https://www.unlv.edu/provost/transparency

Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring and Coaching—The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit http://www.unlv.edu/asc or call 702-895-3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

UNLV Writing Center—One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: http://writingcenter.unlv.edu/.

Rebelmail—By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

Final Examinations—The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: http://www.unlv.edu/registrar/calendars.