CE 271 ADVANCED STRUCTURAL ANALYSIS (Project-Based) (3-credit)

**Fall Semester - 2020**

**Mode of Instruction:** INPR

**Time:** MWF 12 – 12:50 PM

**Class Room:** INNOVATION HALL E210

**Course Website:** Blackboard

**Instructor:** Dr. Priyantha Wijesinghe

**Office:** VOTEY 235A

**E-mail:** pwijesin@uvm.edu

**Office Hours:** M &F 9 – 10 AM and W 3 – 5 PM or by appointment. Office hours will be held via MS Teams. Join MS Teams meetings during these times.

**COURSE CATALOG DESCRIPTION:**

**CE 271 – Advanced Structural Analysis.** Virtual work, energy theorems, analysis of structures by the displacement method and the finite element method, non-linear structural analysis.

Prerequisites: CE 170

**COURSE OBJECTIVES:**

This course is mainly focused on the matrix method of structural analysis. Students will apply the matrix method to analyze statically indeterminate linear 3D frames and trusses. Students will also gain an in depth understanding of the structural analysis software developed from matrix theory. Working in groups, students will analyze real-world structures using commercial structural analysis software, compare the results with theoretical calculations and prepare summary reports. Additionally, the advanced topics such as plastic analysis and finite element method will be introduced.

***Specific Learning Outcomes and Objectives:***

1. Review of fundamental concepts from CE 170 Structural Analysis: analysis of statically

determinate (SD) structures and internal loadings developed in structural members

1. Analyze statically indeterminate trusses and frames using approximate methods
2. Review and analyze more complex problems using Energy Methods (virtual work and Castegliano’s theorem)
3. Analyze SI structures using Force Method
4. Review basic matrix concepts and linear algebra
5. Analyze trusses using the Stiffness Method
6. Analyze beams using the Stiffness Method
7. Analyze plane frames using the Stiffness Method
8. Apply structural modeling and computer simulations to analyze real-world structures

**RELATIONSHIP TO ABET STUDENT OUTCOMES (Criterion 3)**

|  |  |  |
| --- | --- | --- |
| ***Level of Instruction******(1-2)****M: moderate**H: High* | ***Outcome #*** | ***ABET Outcome*** |
| *H* | *1* | *an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics* |
| *M* | *2* | *an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors* |
| *M* | *5* | *an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives* |
| *H* | *7* | *an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* |

**REFERENCES:**

* Ghali, A., Neville, A., Brown, T. G. (2003). A Unified Classical and Matrix Approach, 5th Ed., Spon Press, London & NY
* Menon, D., (2009). Advanced Structural Analysis, Narosa Publishing House
* Hibbeler, R. C. (2018). Structural Analysis, 10th Ed., Prentice Hall, NJ
* Laible, J. P (1985). Structural Analysis, CBS College Publishing, NY

**PEDAGOGY:**

Students will be led through a review of reading assignments and several relevant example problems in

each lecture period with opportunities to pause, reflect, and comment on what they’ve learned. Students

will work in small groups during class and actively involve in their own leaning. Physical models and

simulations will be used to demonstrate key concepts. New topics will be grounded in real world examples

throughout. Students will actively participate in their group project throughout the semester.

**Meeting Pattern, attendance and classroom expectations**

This course is designated as in-person. All students are expected to meet face-to-face for all class meetings.



**Classroom Environment Expectations:**

The [Green and Gold Promise](https://www.uvm.edu/deanofstudents/green-and-gold-promise) clearly articulates the expectations that UVM has for students, faculty, and staff to remain compliant with all COVID-19 recommendations from the federal CDC, the State of Vermont, and the City of Burlington. This include following all rules regarding facial coverings and social distancing when attending class. If you do not follow these guidelines, I will ask you to leave the class. If you forget your mask, you cannot enter the class and should go back and retrieve your mask. The [Code of Student Conduct](https://www.uvm.edu/sites/default/files/UVM-Policies/policies/studentcode.pdf) outlines policies related to violations of the Green and Gold Promise. Sanctions for violations include fines, educational sanctions, parent notification, probation, and suspension.

**Quarantine / Isolation:**

If you need to isolate or quarantine, Student Health Services will inform the Dean’s office. I recommend contacting me and the [CEMS Office of Student Services](https://www.uvm.edu/cems/student-services) as early as possible to make arrangements to discuss any missed work.

**Recording Class Sessions:**

Our class sessions will be audiovisually recorded for students in the class to refer back to, and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live.

**GRADING:**

In-class questions, discussions and “favorite structure” presentation 10%

Quizzes 10% (both in-class and take-home)

Homework 15%

Group Project(s) 35%

Midterm Exams 30% (two in-class exams, each counts 15%)

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Total 100%

The minimum passing grade is 60%. Other grades will be assigned as shown below.

|  |  |
| --- | --- |
| **Letter Grade** | **Numerical Grade** |
| A+ | 97-100 |
| A | 94-97 |
| A- | 90-93 |
| B+ | 87-89 |
| B | 83-86 |
| B- | 80-82 |
| C+ | 77-79 |
| C | 73-76 |
| C- | 70-72 |
| D+ | 67-69 |
| D | 63-66 |
| D- | 60-62 |
| F | <60 |

A statistical scale may be used at instructor’s judgment in addition to the above scale.

**EXAM AND HOMEWORK POLICIES:**

Midterm Exams are scheduled as follows:

***Midterm Exam 1: Friday, October 23, 2020 (in class)***

***Midterm Exam 2: Thursday, November 20, 2020 (in class)***

Make-up exams will be given at the discretion of the instructor. An appropriate, valid documentation of absence will be required for consideration of a make-up exam. It is strongly encouraged to obtain prior permission from the instructor. Examples of valid reasons are; injury or illness that is too severe or contagious for the student to attend, participation in a university authorized activity, death or major

illness in a student’s immediate family, time conflicts with other courses, or important travel plans (made before the first day of class – August 31, 2020).

Homework assignments will be assigned weekly and will be posted on Bb. All homework assignments must be submitted **electronically as a single PDF file** (unless noted otherwise) using the correct Bb assignment link before they are due. Email submissions will not be accepted. You are required to follow the guidelines and the HW format posted on Bb to prepare your solutions. No late assignments will be accepted and there will be no make-up quizzes and no make-up “in-class’ questions and activities.

If you do not have access to a scanner, please use Genius Scan (on iOS) or TinyScanner (on Android) to convert your hand-written solutions to pdf.

**COURSE OUTLINE**

**Unit 1.** Review of fundamental concepts from CE 170 Structural Analysis: analysis of statically

 determinate (SD) structures and internal loadings developed in structural members

**Unit 2.** Statically indeterminate (SI) structures and approximate analysis of SI structures

**Unit 3**. Energy methods (virtual work and Castegliano’s theorem): review and more complex

problems

**Unit 4**. Force method: review and more complex problems

**Unit 5**. Basic matrix concepts and linear algebra

**Unit 6**. Truss analysis using the stiffness method

**Unit 7**. Beam analysis using the stiffness method

**Unit 8.** Plane frame analysis using the stiffness method

**Unit 9**. Structural modeling and computer analysis

**Unit 10**. Plastic analysis and Finite element analysis (if time permits) and computer simulations

**REQUIRED SOFTWARE AND PLATFORMS:**

Please read this technology check list to make sure you are ready for classes. <https://www.uvm.edu/it/kb/student-technology-resources/>
Students should contact the Helpline (802-656-2604) for support with technical issues.

**Important:** Students are required to bring their laptops to class every day. Physical interaction and verbal communication in class maybe restricted due to physical distancing and masks. Be prepared to interact with your peers via technology that are listed below.

This course uses resources in different formats. Please make sure that you can open a PDF document and watch a YouTube video. Adobe Acrobat Reader is needed to view PDF documents. If you do not have adobe reader on your computer you can download it for free from the Adobe website at <http://www.adobe.com>.

**Blackboard (Bb):**

Make sure you are using a supported browser to access Blackboard (Bb). To check your browser and for more help on using Bb, [please follow this link.](https://www.uvm.edu/it/kb/article-categories/bb-for-students/) Additionally, bookmark UVM Tech Team [Knowledge Base](https://www.uvm.edu/it/kb/article-categories/bb-for-students/) to get UVM-specific information, and to get one-on-one help, if needed.

Bb will be used as the primary website to post all course materials, assign and grade all assignments, post grades and weekly announcements etc.

**MS Teams**

MS Teams will be used to (1) deliver synchronous lectures, (2) participate in discussions and group activities, and (3) hold weekly office hours. Please [follow this link](https://www.uvm.edu/it/kb/article/teams/) for instructions to download MS Teams. When you login, you should be able to see *CE271A Advanced Structural Analysis* MS Team.

**Design and Analysis Software**

* *MATLAB* and *SAP2000* via Virtual Votey. Please follow these [instructions](https://www.uvm.edu/cems/virtual-lab) to connect.
* ANSYS: Instructions will be provided in class

**Netiquette**

Netiquette stands for Network Etiquette. It refers to proper behavior while interacting online. The golden rule of netiquette is essentially to treat people as you would want to be treated. Please be polite and considerate. Think about whether your comment could cause hurt feelings. Be careful about how your words can come across because misunderstandings can be common online. [Read this](http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf) to learn more about netiquette.

**Inclusive Learning Environment**

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

**Academic Integrity**

Offences against the **Code of Academic Integrity** are deemed serious and insult the integrity of the entire academic community. This policy addresses plagiarism, fabrication, collusion, and cheating. [https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf (PDF link)](https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf).

Any suspected violations of the code are taken very seriously and will be forwarded to the [Center for Student Conduct](https://www.uvm.edu/sconduct) for further intervention.

**Code of Student Conduct:**

[https://www.uvm.edu/policies/student/studentcode.pdf (PDF link)](https://www.uvm.edu/policies/student/studentcode.pdf)

**COVID-19 Policy Statements**

**General statement regarding potential changes during the semester:**
<http://catalogue.uvm.edu/>
The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

**Green and Gold Promise:**The [Green and Gold Promise](https://www.uvm.edu/deanofstudents/green-and-gold-promise) clearly articulates the expectations that UVM has for students, faculty, and staff to remain compliant with all COVID-19 recommendations from the federal CDC, the State of Vermont, and the City of Burlington.

The [Code of Student Conduct](https://www.uvm.edu/sites/default/files/UVM-Policies/policies/studentcode.pdf) outlines policies related to violations of the Green and Gold Promise. Sanctions for violations include fines, educational sanctions, parent notification, probation, and suspension.

## **Intellectual Property Statement/Prohibition on Sharing Academic Materials:**

Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example homework or a take-home examination). Violations will be handled under UVM’s Intellectual Property policy and Code of Academic Integrity.

**Student Learning Accommodations:**

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Student Accessibility Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student’s accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan. Contact SAS: A170 Living/Learning Center: 802-656-7753 (phone link).

**Contact Student Accessibility Services (SAS):**

A170 Living/Learning Center
802-656-7753 (phone link)
access@uvm.edu (email link)
<https://www.uvm.edu/academicsuccess/student_accessibility_services>

**UVM’s policy on disability certification and student support:**

[https://www.uvm.edu/policies/student/disability.pdf (PDF link)](https://www.uvm.edu/policies/student/disability.pdf)

**Health and Wellbeing**

The Center for Health & Wellbeing (CHWB) offers a wide range of services to support your mind, body, and soul while you're at UVM. The Student Health Services staff of board certified physicians, physician assistants, nurse practitioners, nurses, and dietitians work with patients and collaborate with other CHWB providers to ensure personalized and timely care to UVM students. Counseling & Psychiatry Services (CAPS) offers short-term individual counseling, urgent needs counseling, group counseling, outreach and education, psychiatry, referrals, and consultation services.

Please visit their website at: <http://www.uvm.edu/~chwb/> to find out more.

At Living Well they believe that mental and physical health go hand in hand. They have a variety of programs that offer you the space to create a wellness practice that will support your goals and positive intentions. I highly recommend you to visit their LivingWell website at <http://www.uvm.edu/~chwb/livingwell/> and checkout the meditation and yoga videos.

Extensive research has shown the benefits of meditation towards the learning process.

<http://www.huffingtonpost.com/2013/04/08/mindfulness-meditation-benefits-health_n_3016045.html>

**Counseling & Psychiatry Services (CAPS)**

Phone: (802) 656-3340
If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at <https://www.uvm.edu/deanofstudents>.
Counseling and Psychiatry Services: <https://www.uvm.edu/health/CAPS>

**Tips for Success:**

***Course-specific study/preparation tips***Checklist for success in <https://learn.uvm.edu/about/support-for-students/checklist-online-credit-courses/>

* Academic support for online courses: <https://www.uvm.edu/academicsuccess/online-learning-student-resources-remote-instruction>
* 30-minute webinar on online learning success (Mar 2020): <https://www.youtube.com/watch?v=Xp_MYsqQyvE>

Helpful resources other than the professor (e.g. [Undergraduate/Graduate Writing Center](https://www.uvm.edu/uwi/writingcenter), [Supplemental Instruction, Learning Co-op tutors](https://www.uvm.edu/academicsuccess/tutoring_center), supplemental course materials)

**Religious Holiday Policy Statement**

Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the end of the first week of classes. You will be permitted to make up work within a mutually agreed-upon time.

**Grading:**

Your grades will be posted on Bb. Please check your grades frequently and notify me if you find any mistakes.

For information on grading and GPA calculation, go to the Registrar’s page on grading. <https://www.uvm.edu/registrar/grades> .

**Grade Appeals:**

If you would like to contest a grade, please follow the procedures outlined in this policy: [https://www.uvm.edu/policies/student/gradeappeals.pdf (PDF link)](https://www.uvm.edu/policies/student/gradeappeals.pdf)

**FERPA Rights Disclosure:**

The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974. [https://www.uvm.edu/policies/student/ferpa.pdf (PDF link)](https://www.uvm.edu/policies/student/ferpa.pdf)

**Final exam policy:**

The University final exam policy outlines expectations during final exams and explains timing and process of examination period. <https://www.uvm.edu/registrar/final-exams>

**Statement on Alcohol and Cannabis in the Academic Environment**

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

* Cause issues with attention, memory and concentration
* Negatively impact the quality of how information is processed and ultimately stored
* Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.