

UNIVERSITY OF NORTH TEXAS – Department of Mechanical Engineering

MEEN 4150 **Capstone Design I**

SYLLABUS

Spring 2024

3 Credit hours

<b>Instructor:</b>	Dr. Hassan Qandil ( <a href="mailto:hassan.qandil@unt.edu">hassan.qandil@unt.edu</a> )
<b>Office Hours:</b>	Saturdays (By appointment via Zoom)
<b>Lecture:</b>	MoWe 10:00AM - 11:20AM - NTDP F175
<b>CAE Labs:</b>	Sat 10:00AM - 4:00PM- Pettinger Center for Design and Innovation (Optional)
<b>Fabrication Labs:</b>	Check with the EMF and the Pettinger Center for Design and Innovation staff
<b>TAs:</b>	TBA
<b>TA Office Hours:</b>	TBA

**PREREQUISITES:** NOT be pre-engineering major, passed the following “C” or better:

- 1) EENG 2610 or ENGR 2405: Circuit Analysis
- 2) MEEN 3130: Machine Element Design
- 3) MEEN 3210: Heat Transfer
- 4) MEEN 3230: System Dynamics and Control

**CO-REQUISITES:**

- 1) MEEN 4150.3XX: Senior Design Laboratory
- 2) MEEN 3100: Manufacturing Processes

**CATALOG COURSE DESCRIPTION:**

Advanced treatment of engineering design principles with an emphasis on product and systems design, development and manufacture. Mimics “real world” environment with students working in teams to prepare product specification, develop several concepts, perform detailed design, and construct prototypes subject to engineering, performance and economic constraints.

**LEARNING OUTCOMES:**

1. Gain experience working in teams
2. Apply program management skills such as budgeting, scheduling, parts selection
3. Apply engineering knowledge to design / construct solutions to real-world problem.
4. Enhance technical communications skills through written reports and presentations

**REQUIRED TEXTBOOK:**

“*Engineering Design*”, George Dieter, Linda Schmidt. McGraw Hill (ISBN: 1260113299), 2021.

**OPTIONAL RESOURCES AND TEXTBOOKS:**

- 1) “*Engineering Design with SOLIDWORKS 2023*”, David C. Planchard, SDC Publications, (ISBN: 978-1-63057-550-2), 2021.
- 2) “*Engineering Analysis with SOLIDWORKS Simulation 2023*”, David C. Planchard, SDC Publications, (ISBN: 978-1-63057-552-6), 2023.
- 3) “*Control Systems Engineering*”, Norman S. Nise, WILEY, (ISBN: 978-1119721406), 2020.

**ABET Major Design Experience:**

This course satisfies an ABET accreditation requirement for a major design experience. “Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade-offs, for purpose of obtaining a high-quality solution under given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability”

**ABET Program Educational Objectives (PEO's):**

PEO's developed by department stakeholders and supported by senior design capstone course are:

1. Graduates successfully employed in mechanical and/or energy engineering positions and other related fields.
2. Graduates engage in lifelong learning demonstrated by advanced education, professional development activities and/or other career-appropriate options.
3. Graduates are prepared to successfully demonstrate technical and leadership competence through ethical conduct, teaming, communication and/or problem-solving skills learned in our program

**ABET OUTCOMES:**

1. Identify, formulate, and solve complex engineering problem by applying principles of engineering science and mathematics.
2. Apply engineering design to produce solutions to meet specified needs with consideration of public health, safety, welfare, global, cultural, social, environmental, economic factors
3. Communicate effectively with a range of audiences.
4. Recognize ethical/professional responsibilities in engineering situations and make informed judgements, which must consider impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Function effectively on team whose members together provide leadership, create a collaborative/inclusive environment, establish goals, plan tasks, meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. Acquire and apply knowledge as needed, using appropriate learning strategies.

**GRADES:**

Standard grading scale used: 90/80/70/60. All members receive same score for team assignments unless evidence of non-participation exists. Individual scores for individual assignments. Extended deadlines are NOT allowed only exception being University excused absences with documentation.

<b>Conceptual Design (CD) Labs</b>	MEEN 4150
1. Team Contract	4
2. Project Definition	4
3. Team Vision and Voice of Customer	4
4+5. Literature and Patent Search	4
6. Product Design Specifications	8
<b>Preliminary Design (PD) Labs</b>	
7. Brain Storming	4
8. Concept Generation and Selection	4
9. Embodiment Design	4
<b>Midterm Presentation + 3D Printed Concept</b>	7
<b>Team Meeting Minutes</b>	5
<b>Computer Aided Engineering (CAE) Labs</b>	25
<b>Final Presentation</b>	7
<b>Final Report</b>	15
<b>Class Attendance + Peer Review</b>	5
<b>Risk Management / Safety Planning</b>	Pass/Fail
<b>SPOT Evaluation</b>	1 (Extra)
<b>4250 Design Day Attendance (Apr. 26<sup>th</sup>, 2024)</b>	2 (Extra)

**TENTATIVE CLASS SCHEDULE (Submissions: Green=Team, Pink=Individual)**

Week	Dates	Mondays	Wednesdays	Lab Due	Project Due	Other Due	
1	Jan. 16 <sup>th</sup> – Jan. 20 <sup>st</sup>	<b>No class Jan-15<sup>th</sup></b>	Intro / Think Tank				
2	Jan. 22 <sup>nd</sup> – Jan. 26 <sup>th</sup>	Pitch Day	Engineering Design/Product-Development Process			Survey	
3	Jan. 29 <sup>th</sup> – Feb. 2 <sup>nd</sup>	Basic Part Modeling	Team Behavior and Tools / GANTT Chart		CD-1, CD-2	Team Schedule	
4	Feb. 5 <sup>th</sup> – Feb. 9 <sup>th</sup>	Symmetry and Draft, Patterning	Gathering Information	HW-1	CD-3		
5	Feb. 12 <sup>th</sup> – Feb. 16 <sup>th</sup>	Revolved Features, Shelling and Ribs	Problem Definition and Need Identification	HW-2	CD-4		
6	Feb. 19 <sup>th</sup> – Feb. 23 <sup>rd</sup>	Global Variables, Using Drawings	Concept Generation	HW-3	CD-5		
7	Feb. 26 <sup>th</sup> – Mar. 1 <sup>st</sup>	Risk Management / Safety Planning	Embodiment & Detail Design	HW-4	PD-7		
8	Mar. 4 <sup>th</sup> – Mar. 8 <sup>th</sup>	Finite Element Analysis Intro	Public Speaking		PD-8		
9	Mar. 11 <sup>th</sup> – Mar. 15 <sup>th</sup>	<b>Spring Break</b>					
10	Mar. 18 <sup>th</sup> – Mar. 22 <sup>nd</sup>	<b>(Midterm Presentations + 3D Printed Concept)</b>					
11	Mar. 25 <sup>th</sup> – Mar. 29 <sup>th</sup>	Stress & Thermal Analysis	Decision Making and Concept Selection	HW-5	PD-9		
12	Apr. 1 <sup>st</sup> – Apr. 5 <sup>th</sup>	Frequency Analysis / Fluid Flow Analysis	Virtual Reality Design Team (Team Demo)	HW-6		Risk & Safety	
13	Apr. 8 <sup>th</sup> – Apr. 12 <sup>th</sup>	Simulink Intro	Arduino/ Raspberry Pi Intro	HW-7			
14	Apr. 15 <sup>th</sup> – Apr. 19 <sup>th</sup>	ANSYS Intro	ANSYS Intro				
15	Apr. 22 <sup>nd</sup> – Apr. 26 <sup>th</sup>	<b>(Final Presentations)</b>				Final Report	Peer Rev.
16	Apr. 29 <sup>th</sup> - May 3 <sup>rd</sup>	<b>NO CLASS – FINALS Prep</b>					

**COURSE POLICY: Course delivery method is in-person.** All course announcements, lecture notes, recorded material and assignments will be posted on the MEEN 4150 Canvas courses. *Students are expected to have access to the textbook on their own.*

**ASSIGNMENTS:**

All **submissions are online through CANVAS and in a PDF format. NO LATE SUBMISSIONS ALLOWED** except for students with UNT-approved excuse (please follow UNT Policy 06.039). **ALL late/missed assignments earn 0 grade.** If you have an emergency and need an authorized absence as per UNT Policy 06.039, **please connect with the Dean of Students' office requesting an excused absence in writing ([studentaffairs.unt.edu/dean-of-students](http://studentaffairs.unt.edu/dean-of-students)).**

**TEAMWORK:**

1. **Teamwork is a major objective.** Each team member expected to contribute equally. Team members evaluate each other. Evaluations play a role in grades. If team feels a member not supportive, instructor should be notified.
  - a. Lack of participation in team activities or contribution to the design process
  - b. Unethical behavior such as plagiarism or fabricating test results
  - c. Poor working relationships with team members, advisors, staff members
  - d. Not meeting deadlines or Misuse of project materials
  - e. Actions which jeopardize team progress
2. **Missing meetings and not assisting teammates because of employment, is not excusable per UNT policy.** Students must adjust schedules. Your team must find times to meet acceptable to everyone.
3. **Instructor reserves right to reduce student grade based on lack of team work. This includes dropping student, even if all individual grades otherwise passing.**

**FACE COVERINGS:** Consistent with CDC guidelines and state policy, individuals are not required to wear face coverings on UNT's campuses. Non-vaccinated individuals are encouraged to wear a face covering. Face covering guidelines could change based on community health conditions.

**ATTENDANCE:** Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the professor and the instructional team prior to being absent, so you, the professor, and the instructional team can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community.

If you experience any symptoms of COVID-19 (<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or [askSHWC@unt.edu](mailto:askSHWC@unt.edu)) or your health care provider PRIOR to coming to campus.

**[IF NEEDED] COURSE MATERIALS FOR REMOTE INSTRUCTION:** Remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to a webcam and microphone to participate in fully remote portions of the class. Information on how to be successful in a remote learning environment can be found at <https://online.unt.edu/learn>

## **DESIGN PROJECT REQUIREMENTS**

- 1) Design projects must be related to mechanical engineering. Project should be the design of a device, machine or system that implements mechanics, thermal, fluids, energy, and control systems modeling. Project must have broad enough scope that it demonstrates a student's knowledge of mechanical fundamentals. Projects may include non-mechanical portions such as electronics and instrumentation, but they may not be primary discipline. Project solutions must involve three or more of the following mechanical engineering disciplines:
  - a. Solid mechanics / Fluid mechanics
  - b. Machine design
  - c. Energy Systems, HV
  - d. Thermal systems / heat transfer
  - e. Decision Sciences - Systems modeling and feedback controls
  - f. Manufacturing Processes
- 2) Projects and solutions must be open-ended that require an engineer to solve a problem. A problem with one obvious solution is not acceptable. Having many workable solutions allows teams to determine the "best" solution and provide reasoning behind their selection. Multiple alternatives are presented and evaluated, with a decision process which assesses how to determine final design configuration.
- 3) Projects and solutions are required to have specific constraints which are measurable, i.e., weight, size, cost, performance, efficiency, etc. Measurable goals and constraints are developed and documented in a system specification.
- 4) Projects and solutions must require background research to be done. If the solution has already been published, the project is not acceptable.
- 5) Projects and solutions require proof that design is feasible to manufacture, functional, and safe. Analysis helps reduce risk of failure before fabrication but is not proof. Fabrication and tests are required.
- 6) Projects and solutions must be able to be completed within 2 semesters.
- 7) Projects must be complex enough to require at least 3 students, but not more than 6
- 8) Projects and solutions should be complex enough to allow each team member to have responsibility for a major design element. If a team can implement a solution, buy materials and build it without any engineering analysis to reduce risk or assess capability versus safety or performance requirements - it is not acceptable. Simple solutions require additional scope to provide all students equal opportunity to accomplish degree requirements. Each student must be provided opportunity to lead design of major design element or assembly (collection of parts) that requires:
  - a. Preliminary Design: problem identification, research and concept development
  - b. Embodiment Design: the main concept is selected and further analyzed
  - c. Detailed Design: computer engineering analysis using solid modeling FEA
  - d. Fabrication: construct using generally accepted engineering fabrication methods and materials. 3-d printing is, in general, specifically excluded.
  - e. Test: Instrument, test, and evaluate design and compare to analysis.
  - f. Blueprints - create detailed part and assembly drawing of component

**COMMUNICATING WITH INSTRUCTOR:** The primary method of communication during lecture time for design questions. Periodic instructor team conferences (meetings) are also scheduled in the MEE office. Personal questions or concerns should be addressed through office hours or individual appointments. Last resort is email or office phone. Response times to email and voice mail communication can be significant and should be avoided.

**ACCESS TO INFORMATION – EAGLE CONNECT:** Students' access point for business and academic services at UNT is located at: [my.unt.edu](http://my.unt.edu). All official communication will be delivered to your Eagle Connect account. For more information, please visit website that explains Eagle Connect and how to forward e-mail: [eagleconnect.unt.edu](http://eagleconnect.unt.edu). **CANVAS is used to post announcements, syllabus, homework, lecture slides, grades, etc.** Instructor can only communicate announcements through CANVAS. For more information, please visit the website that explains Eagle Connect and how to forward e-mail Eagle Connect (<https://it.unt.edu/eagleconnect>).

**COURSE SAFETY PROCEDURES:** Students enrolled in Senior Design are required to use proper safety procedures and guidelines as outlined in UNT Policy 06.038 Safety in Instructional Activities. While working in laboratory sessions, students are expected and required to identify and use proper safety guidelines in all activities requiring lifting, climbing, walking on slippery surfaces, using equipment and tools, handling chemical solutions and hot and cold products. Students should be aware that the UNT is not liable for injuries incurred while students are participating in class activities. All students are encouraged to secure adequate insurance coverage in the event of accidental injury. Students who do not have insurance coverage should consider Standard Syllabus Statements Related Policy 06.049 Course Syllabi Requirements obtaining Student Health Insurance. Brochures for student insurance are available in the UNT Student Health and Wellness Center. Students who are injured during class activities may seek medical attention at the Student Health and Wellness Center at rates that are reduced compared to other medical facilities. If students have an insurance plan other than Student Health Insurance at UNT, they should be sure that the plan covers treatment at this facility. If students choose not to go to the UNT Student Health and Wellness Center, they may be transported to an emergency room at a local hospital. Students are responsible for expenses incurred there.

**ACCEPTABLE BEHAVIOR:** Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. To learn more, visit UNT's Code of Student Conduct (<https://deanofstudents.unt.edu/conduct>).

**EMERGENCY NOTIFICATION & PROCEDURES:** Students' access point for business and academic services at UNT is located at: my.unt.edu. All official communication from the University will be delivered to a student's Eagle Connect account. For more information, please visit the website that explains Eagle Connect and how to forward e-mail: eagleconnect.unt.edu/

**ACADEMIC INTEGRITY STANDARDS AND SANCTIONS FOR VIOLATIONS:** Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. Academic dishonesty will not be tolerated and will result in score of zero on the assignment. The student will be reported to Office of Academic Integrity for appropriate disposition. No exceptions

**ADA Policy:** UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website (<https://disability.unt.edu/>).

**STUDENT PERCEPTIONS OF TEACHING EFFECTIVENESS (SPOT):** Student feedback is important and an essential part of participation in this course. The student evaluation of instruction is a requirement for all organized classes at UNT. The survey will be made available during weeks 13, 14 and 15 of the long semesters to provide students with an opportunity to evaluate how this course is taught. Students will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-reply@iasystem.org) with the survey link. Students should look for the email in their UNT email inbox. Simply click on the link and complete the survey. Once students complete the survey they will receive a confirmation email that the survey has been submitted. For additional information, please visit the SPOT website at <http://spot.unt.edu/> or email [spot@unt.edu](mailto:spot@unt.edu). SPOT evaluations performed in class during last couple weeks of semester.

**RETENTION OF STUDENT RECORDS:** Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via the CONVAS online system, including grading information and comments, is also stored in a safe electronic environment for one year. Students have the right to view their individual

record; however, information about student's records will not be divulged to other individuals without proper written consent. Students are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the University's policy. See UNT Policy 10.10, Records Management and Retention for additional information.

**SEXUAL ASSAULT PREVENTION:** UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination based on sex, and therefore prohibit sexual misconduct. If you or someone you know is experiencing sexual harassment, relationship violence, stalking, and/or sexual assault, there are campus resources available to provide support and assistance. UNT's Survivor Advocates can assist a student who has been impacted by violence by filing protective orders, completing crime victim's compensation applications, contacting professors for absences related to an assault, working with housing to facilitate a room change where appropriate, and connecting students to other resources available both on and off campus. The Survivor Advocates can be reached at [SurvivorAdvocate@unt.edu](mailto:SurvivorAdvocate@unt.edu) or by calling the Dean of Students Office at 940-565- 2648. Additionally, alleged sexual misconduct can be non-confidentially reported to the Title IX Coordinator at [oeo@unt.edu](mailto:oeo@unt.edu) or at (940) 565 2759

**SYLLABUS CHANGES:** Instructor reserves right change the syllabus. Any changes will be announced in class and posted to CANVAS with accompanying email to student's UNT email address.