UNIVERSTY OF NORTH TEXAS – MECHANICAL ENGINEERING
MEEN 4410/5800-011 ENERGY HARVESTING SYLLABUS - Fall 2020 - 3 Credit hours

Instructor: Dr. Hassan Qandil (Hassan.Qandil@unt.edu)
Course Time and Place: TuTh 11:30 am -12:50 pm, Remote (Via Live Zoom Lectures).
Instructor Office and Hours: By appointment via Zoom.
Teaching Assistant: TBD
TA Office and Hours: By appointment via Zoom.

Catalog Course Description:
Ambient energy harvesting, known as energy scavenging or power harvesting, is the process of obtaining energy from the environment and converting it to electricity. A variety of mechanisms are available for energy scavenging, including photoelectricity, piezoelectricity, pyroelectricity, thermoelectricity, and kinetic harvesters. Such systems have a wide range of applications including energy efficiency enhancement, embedded power sources for wireless sensor networks, and embedded power for biomedical devices.

This course introduces the design and engineering of some energy harvesting systems including photovoltaic, mechanical, thermal, thermoelectric, pyroelectric, electrostatic, osmotic and metamaterial based.

Pre-requisite(s):
MEEN 3230 and ENGR 2405 (or EENG 2610) with grade C or higher, senior or graduate student status.

Recommended Textbooks:
- Energy Harvesting for Autonomous Systems - Stephen Beeby and Neil White, Artech House.
- Energy Autonomous Micro and Nano Systems – Marc Belleville and Cyril Condemine, Wiley.
- Energy Materials – Duncan Bruce, Dermot O'Hare, Richard Walton, Wiley.
- Energy Harvesting Technologies – Shashank Priya, Daniel Inman, Springer

Course Learning Outcomes (CLO):
Upon successful completion of this course, students will able to:

A. Create predictive models for harvesting energy from various sources such as motion, vibration, acoustics, and waste heat.
B. Understand fundamental and constitutive laws for some common physical concepts including electrostatic, pyroelectric, osmotic, piezoelectric, photoelectric, and thermoelectric.
C. Be able to design and apply fundamentals of physics to harvest ambient energy.
D. Employ skills learned of energy harvesting to research more advanced and novel methods like the use of metamaterials.

ABET Student Learning Outcomes (SO):

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
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.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
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.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

CLO	ABET Student Outcomes (SO)						
	1	2	3	4	5	6	7
A	X						
B	X						
C	X	X					
D	X				X		X

Calculators: The only calculators that are approved for this course are those permitted on the Fundamentals of Engineering (FE) exam toward Professional Engineer (PE) licensing:

1) Hewlett Packard—HP 33s and HP 35s models, but no others.
2) Casio: All fx-115/991. Any Casio must contain fx-115 or fx-991 in name
3) Texas Instruments: All TI-30X/36X models. Any TI must contain either TI-30X/36X

GRADES: Standard grading scale used: 90/80/70/60. Re-grade request must be made in class the day returned. No re-grade requests after class dismissed. Entire exam will be re-graded, which may result in lower score than originally assigned. **Make-ups are NOT allowed** only exception being University excused absences with documentation provided.

Attendance	5% Taken via ZOOM (Extra credit for lecture participation)
Homework	20% Online PDF submissions, problem solving / critical thinking
Quizzes	20% Online, problem solving, like home practice
Mid Term	25% Online, reading comprehension / multiple choice / qualitative
Final Exam	30% Online, reading comprehension / multiple choice / qualitative

10% Extra Credit is available through an OPTIONAL final project

ACCEPTABLE BEHAVIOR: I consider this class to be place where you will be treated with respect and fairness. All expected to contribute to respectful and inclusive environment. Students engaging in unacceptable behavior that may violate the Code of Student Conduct will be directed to leave the ZOOM session and the instructor may refer the student to the Dean of Students for investigation. We enforce student Code of Student Conduct at deanofstudents.unt.edu/conduct.

TENTATIVE LECTURE SCHEDULE

Week	Dates	Topic	Topic	Quiz
1	Aug. 24th – Aug. 28th	1	Introduction to energy harvesting	
2	Aug 31st– Sept. 4th	1	Introduction to energy harvesting	
3	Sept. 7th–Sept. 11th	2	Photovoltaic (PV) energy harvesting	
4	Sept. 14th–Sept. 18th	2	Photovoltaic (PV) energy harvesting	1
5	Sept. 21st- Sept. 25th	3	Mechanical energy harvesting	
6	Sept. 28th - Oct. 2nd	3	Mechanical energy harvesting	
7	Oct. 5th-Oct.9th	4	Thermoelectric energy harvesting	2
8	Oct. 12th- Oct. 16th	4	Thermoelectric energy harvesting	
Midterm (Monday, October 19th) 11:30 am - 12:50 pm (Topics 1 - 4) (Online using Lockdown Browser & Respondus Monitor)				
9	Oct. 19th - Oct. 23rd	5	Thermal energy harvesting	
10	Oct. 26th- Oct 30th	5	Thermal energy harvesting	
11	Nov. 2nd- Nov. 6th	6	Osmotic energy harvesting	3
12	Nov. 9th- Nov. 13th	7	Pyroelectric energy harvesting	
13	Nov. 16th- Nov. 20th	8	Electrostatic energy harvesting	
14	Nov. 23rd- Nov. 27th	9	Metamaterials	4
15	Nov. 30th - Dec. 4th	-	Review	
Final (Tuesday, December 8th) 10:30 am - 12:30 pm (Topics 5 - 9) (Online using Lockdown Browser & Respondus Monitor)				

(**No Classes Sept. 7th, Nov. 26th & 27th**)

REMOTE COURSE DELIVERY

- All **course announcements, lecture notes, recorded lectures and assignments** will be posted on the MEEN 4110/5800-011 Canvas site. ***Students are expected to have access to the textbook on their own***. I will try to provide recommendations for alternative educational resources that are available online, whenever possible.
- We will mostly have synchronous **(live) Zoom meetings during the regular class meeting times**. All Zoom meeting invitations along with references to Zoom resources will be posted on the MEEN 4110/5800-011 Canvas site. We will **use Zoom chat in lieu of in-class discussions**.

- **It will be the student responsibility to log in to Zoom and join the virtual lecture using the details provided on ZOOM tab in CANVAS.**
- I will hold **virtual office hours** via live Zoom sessions, a student can schedule a meeting by emailing me (hassan.qandil@unt.edu).
- All **assignments** will be posted online via CANVAS. Submissions are also online through CANVAS and in a **PDF format**. **NO LATE SUBMISSIONS ALLOWED** except for students with university-approved excuse.
- All **quizzes and exams** will be conducted via CANVAS using a LockDown browser and Respondus Monitor, which required that the student have access to a webcam and a microphone. For more details, please refer to the following link: https://clear.unt.edu/supported-technologies/respondus-lockdown-browser (Links to an external site.)
- Your **attendance/class participation** will be evaluated based on your participation in Zoom sessions.

ACADEMIC INTEGRITY STANDARDS AND SANCTIONS FOR VIOLATIONS:
According to UNT Policy 06.003, 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 zero assignment score and reported to Office of Academic Integrity. No exceptions. Having any calculator not on the approved list is a violation of Academic Integrity.

ADA STATEMENT:
UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify eligibility. If a disability verified, ODA will provide student with 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. For additional information see the ODA website at disability.unt.edu

STUDENT PERCEPTIONS OF TEACHING EFFECTIVENESS (SPOT)
Course participates in SPOT evaluations (http://spot.unt.edu/ or email spot@unt.edu).

RETENTION OF STUDENT RECORDS Course
Follows Family Educational Rights and Privacy Act (FERPA) laws and UNT Policy 10.10, Records Management and Retention.

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