MEEN 5000 Energy: The Fundamentals

and

MEEN 4810-017 Topics in MEE

FALL 2022

Instructor:	Weihuan Zhao
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Lecture Time:	Tuesday & Thursday **5:30-6:50pm**; Room NTDP B158
Instructor Office Hours:	Tuesday & Thursday: 3:00-4:00pm plus open office policy

Instructional Assistant (IA): Pavani Majjiga (pavanimajjiga@my.unt.edu)

Course Description

Concept of energy and energy conversion; Fossil fuels: coal, oil, and natural gas; Thermal power plants; Energy distribution; Direct energy conversion; Nuclear energy; Renewable energy: hydroelectric power, solar energy and photovoltaic, wind energy, tidal energy, geothermal energy, biomass fuel, hydrogen energy, and fuel cell; Energy storage and battery; and Future Technologies.

Prerequisites: Consent by department

References:

Efstathios E. Michaelides, Alternative Energy Sources, Springer-Verlag, 2012, ISBN 973-3-642-20950-5.

John Twidell and Tony weir, Renewable Energy Sources, 2nd edition Taylor & Francis, 2006.

Tushar K. Ghosh and Mark A. Prelas, Energy Resources and Systems, Vol. 1: Fundamentals and Non-Renewable Resources, Springer-Verlag, 2009.

Tushar K. Ghosh and Mark A. Prelas, Energy Resources and Systems, Vol. 2: Renewable Resources, Springer-Verlag, 2011.

Gerard M. Crawley, Ed., Fossil Fuels, World Scientific, 2016.

Gerard M. Crawley, Ed., The World Scientific Handbook of Energy, Vol. 3, World Scientific, 2013.

Umesh C. Sharma, Non-Conventional Sources of Energy, Studium Press, Houston, 2014.

J. W. Tester et al., Sustainable Energy: Choosing Among options, MIT Press, 2005.

Aldo Vieira da Rosa, Fundamentals of Renewable Energy Processes, Elsevier, 2009.

Paul Kruger, Alternative Energy Resources: The Quest for Sustainable Energy, John Wiley, 2006.

Christian Ngo and Joseph B. Natowitz, Our Energy Future: Resources, Alternatives and the Environment, 2nd Edition, John Wiley, 2016.

V. V. N. Kishore, Renewable Energy Engineering and Technology: Principles and Practice, Fundamentals of Renewable Energy Processes, Earthscan, 2009.

Course policy

- Attendance is mandatory for this course. In case of absence due to unavoidable reasons, documented evidence must be provided.
- Power point slides for each class will be posted on Canvas a few days before the lecture. You are advised to go through those slides in advance. This would help in following the lectures and Q&A.
- Several assignments will be given. In preparing your answers/write-ups you are encouraged to consult reference materials and browse internet. Also, you can borrow diagrams/charts/tables in support of your answers. The typed/written answers should be submitted on-line via one single pdf file by the due dates.
- All assignments and reports for project must be submitted at the beginning of the lecture on prescribed deadlines or earlier.
- **NO late homework will be collected. Exceptions** (late homework will be collected): medical emergence (student and important ones), religious holidays/duty, jury duty and military duty. Evidences must be submitted.
- **Midterm and final exams are closed book, closed notes.**
- All exams will cover materials presented through the slides, discussed during the lectures, and contained in the reading/homework assignments.
- **There will be NO make-up exams. Exceptions**: medical emergency (student and important ones), religious holidays/duty, jury duty and military duty. Evidences must be submitted.
- The course writing assignments and tests are individual work by a student. A student is expected to work on her/his own and write the report/test using own words and figures/charts with proper references.
- Student Perceptions of Teaching (SPOT) Completion: The students should complete the SPOT, which is a short survey. The SPOT is a requirement for all organized classes at UNT. SPOT will be made available to students at the end of the semester to provide them a chance to comment on how this class is taught. The instructor is very much interested in constructive feedbacks from the students to continually improve his teaching of this course.

Calculator

Graphing calculators will not be allowed during quizzes and exams. Only NCEES-approved calculators can be used (http://ncees.org/exams/calculator/).

Acceptable calculators are:

- Casio: All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
- Hewlett Packard: The HP 33s and HP 35s models, but no others.
- Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name.)

Disability Accommodations: If you need academic accommodations for disability you must have document which verifies the disability and makes you eligible for accommodations, then you can schedule an appointment with the instructor to make appropriate arrangements. For more information, please refer the Office of Disability Accommodation website at https://disability.unt.edu/

Academic Dishonesty

There is a zero-tolerance policy for academic dishonesty. Cheating of whatsoever will result in an automatic 'F' in this course and the matter will be turned over to the appropriate student disciplinary committee.

IMPORTANT EXAM DATES

Midterm Exam: Oct. 18th, 2022, Tuesday, 5:30-6:50pm, NTDP B158

Final Exam: Dec. 13th, 2022, Tuesday, 4:00-6:00pm, NTDP B158

Final term paper submission: Dec. 15th, 2022, Thursday (for graduate and grad track students only)

Energy: The Fundamentals Syllabus (Topics to Be Covered)
Schedule Overview

(Please note the schedule may change based on the needs during the semester**)**

Week	**Date**	**Topics**
#1	**Aug.30th – Sep.1st**	**Overview of syllabus; 1. Energy: Basics** **2. Energy Sources**
#2	**Sep.6th - Sep.8th**	**3. Fossil Fuels: Coal;** **4. Petroleum**
#3	**Sep.13th - Sep.15th**	**5. Natural Gas**
#4	**Sep.20th - Sep.22nd**	**6. Nuclear Energy**
#5	**Sep.27th - Sep.29th**	**7. Solar Energy**
#6	**Oct.4th - Oct.6th**	**8. Wind Energy**
#7	**Oct.11th - Oct.13th**	**9. Hydropower**
#8	**Oct.18th - Oct.20th**	**Midterm Exam (Oct. 18th);** **10. Challenges to Alternative Energy**
#9	**Oct.25th - Oct.27th**	**11. Geothermal Energy**
#10	**Nov.1st - Nov.3rd**	**12. Ocean Energy**
#11	**Nov.8th - Nov.10th**	**13. Energy from the Waste;** **14. Energy Storage Technologies**
#12	**Nov.15th - Nov.17th**	**15. Hydrogen as a Fuel**
#13	**Nov.22nd - Nov.24th**	**16. Future Resources: Methane Hydrate, Fusion Energy, Helium 3: Energy from the Moon, Space Solar Power;** **No class, Thanksgiving**
#14	**Nov.29th - Dec.1st**	**17. Building Energy Loads Calculation and Energy Audits**
#15	**Dec.6th - Dec.8th**	**Final term paper presentations (for graduate and grad track students)**
#16	**Dec. 13th, Tuesday (4:00-6:00pm)**	**Final Exam**
	Dec. 15th, Thursday	**Final term paper submission (for graduate and grad track students only)**

Evaluation and Grades

Undergraduates

Home Works (~5):	20%
Attendance and Class Participation:	10%
Midterm Examination:	30%
Final Examination:	40%

≥ 85%	A
70-84.9%	B
55-69.9%	C
40-54.9%	D
< 40%	F

Graduates and Grad Track

Home Works (~5):	15%
Attendance and Class Participation:	5%
Midterm Examination:	25%
Final Examination:	30%
Term Paper and Presentation:	25%

The term paper on a topic as approved by the instructor may be 15-20 page long. It may require 15 minutes presentation plus Q&A.

Term paper:

- A 15-20 page report *(single space, 12 font,* 5000-8000 words) plus figures/charts and references/bibliography.
- A list of 3-4 topics from the list provided to be submitted by September 15 with a paragraph on the scope of each topic and a list of 5-7 key references on each topic.
- The final topic to be determined by September 29 in consultation with the instructor.
- Each student will have an independent topic with no serious overlap with the topic selected by another student. The topics can however be complementary.
- Each student may be required to make a presentation during the last week of the semester and the final report will be due by December 15.

Term Paper Topics

1. **Fossil Fuels, Industrial Revolution, and Technological Growth:**

   Discovery of fossil fuels and their impact on the beginning of industrial revolution, industrial growth, and technological development from the beginning of industrial Revolution to the end of 20^{th} Century.

2. **Current (World-wide) Use of Biomass as one of the Primary Sources of Energy:**

   Analysis of cause and effect of biomass still being used in many countries, particularly Africa and some Asian countries (include the list of countries where 10% of their energy consumptions come from biomass, the list can have many other relevant information); Environmental concerns; Availability of other energy resources in those countries; Future prospect of change; etc.

3. **Products/Byproducts from Oil Refineries and Their Impacts on Modern Civilization:**

   Major products/byproducts from the distillation of crude oil; Their contributions to the development of new energy applications, materials, technologies, medical devices, agriculture, and consumer products as well as to the modern civilization; Commerce, wealth creation, redistribution of financial power, globalization, and international conflicts; etc.

4. **Future of Nuclear Power:**

   Analyze the future of nuclear power considering economic (initial and operational costs, per unit electricity cost), safety/hazard, pollution, waste disposal, social aspects; etc.

5. **Polluting Effects of Solar Cells/Systems:**

   Pollution due to manufacturing of solar cells - from the production of silicon ingots (or other solar materials) to solar panels/systems; Types of pollution; Comparison with pollution by fossil fuels; etc.

6. **Benefits and Drawbacks of Hydropower:**

   Global use of Hydropower, Benefits of the use of hydropower, Negative impacts of construction of hydropower stations, After construction issues with hydropower generation, International issues.

7. **Challenges with Wind power and Wind Farms:**

   Global use of wind power, its popularity and expansion, benefits and challenges of the use of wind power, advantages and drawbacks of on- and off-shore windfarms.

8. **Volcanic Energy:**

   Potential; Geographic locations; Current State-of-the-Art; Environmental impact; Economic Considerations; etc.

9. **Use of Hydrogen in Automobiles:**

   Why hydrogen; Benefits and Challenges; Current State-of-the-Art; Future; etc.

10. **Energy from Ocean - A Dream or Reality:**

    Various methods for harnessing energy from Ocean; State-of-the-art of scientific and technological advancements; Research-based plants; Commercially successful plants; Commercial and geo-political issues; Environmental concerns; Technological and commercial leaders; Reality under what conditions; etc.

11. **Analysis of Return on Energy Investment (ROEI) for the Production of Fossil Fuels and Alternative Energy Resources:**

    Analyze the energy requirements in producing fossil fuels (form extraction to final fuels) and alternative energy resources (from beginning to the end).

12. **Complete Elimination of the Use of Fossil Fuels: Dream or Reality:**

    Analysis of use of fossil fuels vis-à-vis alternate energy sources - power densities in terms of oil equivalent, easy availability, reliability, transmission if used to produce electricity; Future potential.

13. **Electric Vehicles:**

    State-of-the-art of battery for automobiles and its future; Issues with Charging; Cost comparison with respect to oil; Hazards; etc.

14. **Current Status of Progress on Extraction and Use of Methane Hydrate:**

    Benefits and challenges of methane hydrate as a major fuel resource; State-of-the-art of scientific and technological research on MH and related topics; Environmental concern; Financial and geo-political challenges; Dream or Reality (when?); etc.

15. **Helium-3 from Moon for Energy Generation by Fusion:**

    Scientific and technological advantages of using He-3 for fusion; State-of-the-art of research; Expeditions to moon (Moon War?); Technology for transportation from moon; Environmental concern; Technological leaders; Reality under what conditions; etc.

16. **Any other topic with consent from the instructor**