***Course Outline*:**
CHBE 483 / 583 Energy Engineering (Fall 2022)

Course Information

- 3 credits
- September 7 to December 7, 2022
- Monday / Wednesday / Friday: 10:00 am – 11:00 am
- MATH 100 Lecture Room (1984 Mathematics Road, UBC); course lectures are in person
- Class material including class lectures, assignments, notices, etc, will be posted on the Canvas website (https://canvas.ubc.ca)

Course Policy

- Plagiarism will lead to a significant loss of marks or a mark of zero. For example, for the project reports plagiarism programs giving greater than a 10% percent overlap would be considered plagiarism.
- Students are required to uphold academic integrity and honesty, and not to misuse course materials.

Course Description

Supply and use of conventional and alternative fuels and energy technologies. Design and operation of unit operations for processing and adoption of fossil fuels, biomass, renewables and other energy sources. Overview of energy systems, storage and conversion. Techno-economic-environmental assessment of energy technologies and factors affecting alternative energy source/supply and technology adoption.

Some Suggested References (not required):

- J. Tester, E. Drake, M. Driscoll, M. Golay and W. Peters, ***Sustainable Energy (Choosing Among Options)***, The MIT Press, 2005 (ISBN 0-262-20153-4)
- R.A. Hinrichs and M. Kleinbach, ***Energy, Its Use and the Environment***, 4th Edition, Thomson Brooks/Cole, 2006 (ISBN: 0-495-01085-5)- should be available in the bookstore
- Aldo V. da Rosa, ***Fundamentals of Renewable Energy Processes***, 3rd Edition, Academic Press, 2012 (ISBN 978-0-12-397219-4) – available at UBC library as an e-book
- B.K. Hodge, ***Alternative Energy Systems and Applications***, John Wiley & Sons Inc., 2010 (ISBN: 978-0-470-15250-9)
- Godfrey Boyle, Bob Everett and Janet Ramage, ***Energy Systems and Sustainability***, Oxford University Press, 2003 (ISBN: 0-19-926179-2)
- Gilbert Masters, ***Renewable and Efficient Electric Power Systems***, 2nd Edition, Wiley (IEEE Press), 2013 (ISBN 978-1-118-14062-8)
- John Wilson and Griffin Burgh, ***Energizing Our Future (Rational Choices for the 21st Century)***, John Wiley & Sons Inc., 2008 (ISBN 978-0-471-79053-2)
- Richard Dunlap, ***Sustainable Energy***, CENAGE Learning, 2015 (ISBN -10: 1-133-10868-7)

Note: Energy engineering is an exceptionally popular topic among publishers worldwide. There are many books published every month of varying quality and detail.

Teaching

- Instructor: Dr. David P. Wilkinson

- email dwilkinson@chbe.ubc.ca

Note: Office hours of instructor (immediately after class)

-Teaching Assistants (TA): Joseph English, Bingxin Zhou

- Email: joseph.english@ubc.ca
- Email: bxzhou@mail.ubc.ca

Marking CHBE 483 (Undergraduate Students)

Mid-Term Exam	30%
Assignments (4)	20%
Final Exam	50%
	100%

* *Note: it is important that the undergraduate students attend the graduate seminars as there will be some questions on the final exam related to these seminars.*

Marking CHBE 583 (Graduate Students)

Mid-Term Exam	30%
Assignments (4)	20%
Project Report	40%
Seminar	10%
	100%

- **Midterm Exam:** The midterm exam for both **CHBE 483 and CHBE 583 students** will be on Monday (November 7) on material up to and including October 21. More details to come.
- **Final Exam:** The final exam will be for **CHBE 483 students** and will cover the whole term. More details to come.
- **Assignments**: There will be 4 assignments covering course material for both ***CHBE 483 and CHBE 583 students***. Please submit your completed assignments online through Canvas. Late assignments may be penalized.
- **Project Report:** Each ***CHBE 583 student*** will do a project report (with tables and figures, as appropriate) of the state of the art and recent technological developments and future directions in an area covered by, or related to the course. The report should include some discussion of the basic principles related to the alternative energy topic as well. The report should be about 25 to 30 pages in length (not longer) with 1.5 line spacing and 12pt font. The report should be well referenced (include patent literature, if appropriate). Some example project areas are provided but the student may suggest another topic area. Project report topics are to be approved by the instructor by October 7 and reports are to be submitted by December 12. Late submissions will be penalized.
- **Seminar:** Each ***CHBE 583 graduate student*** will present a seminar (12 to 15 minutes(max)) followed by up to 5 minutes of questions / discussion). The seminar can be on the topic covered by the student's project or another approved area related to the course. Make sure figures and data are properly referenced. Seminars will be

scheduled in the last weeks of classes (November 14 to December 7). ***It is important that all students attend since there will be some questions on the final exam related to these seminars.***

Note: Plagiarism can lead to a significant loss of marks or a mark of zero. For example, project reports yielding a greater than 10 % overlap in plagiarism-detection software would be considered plagiarism.

EXAMPLES- Possible Topic Areas for Literature Review Project and Seminar

1. Life cycle assessment of energy production process(es)
2. Different aspects of sustainability to meet future energy requirements
3. Energy management in the future (e.g., deregulation of utilities, internet approach to energy, etc)
4. Methods to reduce green house gases using alternative energy technologies
5. Advances in the removal and use of CO_2
6. Comparison of different sustainable fuel types (energy content, environmental impact, etc)
7. Removal of sulfur and other impurities from sustainable fuels
8. Synthetic / alternative fuels
9. Biofuels
10. High efficiency combustion processes
11. High efficiency turbine technology
12. Latest advances in solar energy production
13. Latest advances in wind energy production
14. Latest advances in hydro energy production
15. Latest advances in geothermal energy production
16. Latest advances in bio energy production
17. Advantages and disadvantages of integration of several energy production methods, e.g., wind/solar/hydro and other combinations
18. Latest advances in nuclear power
19. Hydrogen economy (advantages and disadvantages)
20. Methanol economy (advantages and disadvantages)
21. Hydrogen production
22. Hydrogen storage
23. Comparison of infrastructure costs/requirements for electrification of transportation (hydrogen fuel cells versus batteries)
24. Low temperature fuel cells as an energy conversion device
25. High temperature fuel cells as an energy conversion device
26. Fuel cells as an energy conversion device for biological processes
27. Advantages and disadvantages of hybrid energy systems, e.g., battery / fuel cell, micro-turbine / fuel cell, etc
28. New and novel approaches to energy conversion
29. New and novel approaches to energy storage
30. New and novel approaches to energy engineering for applications (e.g., automotive applications, etc)
31. Modeling and sensors to improve energy efficiency in applications.
32. **Many other topics are possible (and encouraged)!**

Approximate Course Outline: CHBE 483 / 583 (Energy Engineering)

Approximate Dates	Topic Areas	Instructor(s)
Week 1 (Sept 7, 9)	- Course Introduction/ Energy Principles and Definitions; Technology /Sustainability	Wilkinson
Week 2 (Sept 12, 14, 16)	- Green House Gases / Global Warming - Energy Content of Fuels / Characteristics of Fossil Fuels / Energy from Fossil Fuels	Wilkinson
Week 3 (Sept 19, 21, 23)	- Mechanical Energy (transportation) / Heat Engines / Power Plants and Distribution	Wilkinson
Week 4 (Sept 26, 28, 30)	-Nuclear Power (fission/fusion / types of nuclear reactors and principles	Wilkinson
Week 5 (Oct 3, 5, 7)	- Introduction to Renewables - Solar Thermal ***(Project topics approved by Oct 7)***	Wilkinson
Week 6 (Oct 12, 14)	Renewables - Geothermal - Biofuels and Bioenergy ***(Oct 10 Thanksgiving Day: University Closed)***	Wilkinson
Week 7 (Oct 17, 19, 21)	Renewables - Hydro - Wind	Wilkinson
Week 8 (Oct 24, 26, 28)	Energy Storage - Hydrogen and Electrolyzers - Batteries	Wilkinson
Week 9 (Oct 31, Nov 2, 4)	Energy Conversion - Solar PV Devices - Fuel Cells	Wilkinson
Week 10 (Nov 7)	***Midterm Exam (to end of week 7)*** ***(Midterm Break: Nov 9-11)***	Wilkinson
Week 11 (Nov14, 16, 18)	Graduate Student Seminars Start	Wilkinson
Week 12 (Nov 21, 23, 25)	Graduate Student Seminars	Wilkinson
Week 13 (Nov 28, 30, Dec 2)	Graduate Student Seminars	Wilkinson
Week 14 (Dec 5, 7)	Graduate Student Seminars ***(Dec 7 Last Day of Classes)***	Wilkinson
Week 15 →	IMPORTANT ***(CHBE 583 project reports submitted by December 12!!!)*** ***University Exams start: Dec 11 to Dec 22***	