ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Alternative Energy Systems	BEST 202	3 credits

Lecture time and venue

Monday, Wednesday, Friday: 11:00 AM to 12:00 PM
FSC-1001

Prerequisites

[Is there a course that students must have passed before taking this course?]

None

Corequisites

[Is there a course that students must take concurrently (if not before)?]

None

CONTACTS

Course Instructor(s)	**Dr. Jack Saddler** Email: Jack.saddler@ubc.ca Office: 4043 Forest Science Center Office Hours: 1-3 pm PST, Thursdays (15-min block by appointment via Canvas calendar) **Dr. Qingshi Tu** Email: Qingshi.tu@ubc.ca Office: 4040 Forest Science Center Office Hours: 4-5 pm PST (**via Zoom**), Friday (15-min block by appointment via Canvas calendar)
Course TA(s)	**Bidhan Bhuson Roy, PhD student at Department of Wood Science** Email: bbroy@student.ubc.ca Office: 4041 Forest Science Center Office Hours: 4-5 pm PST, Monday (15-min block by appointment via Canvas calendar)

COMMUNICATIONS

The instructors and TA will take an extra effort to ensure that students have sufficient opprotuniteis to communicate their questions and conerns throughout the course. In order to maintain an efficient way

of communication, we ask the students to kindly follow the procedure below when seeking answers to their questions.

When you look for information related to the course, before contacting the Instructor or TA, please make sure to: 1) check the syllabus; 2) check the website (announcements are regularly posted, and all deadlines are included there).

If you still need to contact the Instructor or TA, please follow this hierarchical procedure: 1) ask questions directly during live lectures; 2) post the question in Discussion board on Canvas; 3) book a one-on-one appointment with the TA or one of the instructors via Canvas Calendar; 4) email the instructor (Qingshi Tu) if the issue still remains unsolved.

Also, please make sure you know **who to contact regarding specific matters**:

- Contact the **TA** regarding: lecture attendance issues, assignment grade inquiries, penalties, medical notes and concessions, etc.; the TA has full authority regarding all the aspects of the assignments.
- Contact the **instructor** regarding: lecture material and theory, tutorials, midterm and exam.

COURSE DESCRIPTION

A comprehensive introduction to technologies for safe, clean, and sustainable supplies of energy. Examples include direct solar energy, bioenergy, liquid biofuels, hydro and tidal, wind, and geothermal. In addition to technological aspects, students will explore the economic, social, environmental, and policy issues raised by these systems of energy use and production.

COURSE STRUCTURE

There are **three synchronous lectures each week**. **The lecture on Wednesdays will be recorded to accommondate a possible conflict in schedule with another course**. The Instructor and TA will strive to offer a high level of presence both during and outside these synchronos sessions.

Lecture slides and vidoes cover the key concepts, theory and engineering principles of each energy system. Learning activities, such as polling, in-class discussions and investigative case studies, encourage the active participation of students during the synchronous sessions. Pre-/post-lecture quizzes, surveys and assignments will enable students to gauge their learning progress. The content of assignment and exams will be closely aligned with the learning objectives, materials and activities covered during the lectures.

All learning materials (except the textbook) will be made available through UBC Canvas learning management system. The course will be delivered in modules and students will be able to track their progress in Canvas as coursework is being completed, mark them as done for a visual illustration of progress, and make sure they meet deadlines. Canvas will allow students to navigate through the course progressively and smoothly. Deadlines for the completion of assignments and quizzes will be established, but there will be flexibility for students to work on the materials on their own time.

The students are encouraged to create **an *optional* course portfilo** (up to 5% extra credit will be added to the final mark) to keep track of their reflections (e.g., from lectures or assignments), learning progress and milestones accomplished. The portofilo will serve as a long-lasting document for students to reinforce the learning or to prepare for further study in alternative energy systems, after the completion of this course.

There will be **one midterm essay** and **one final case study** to be completed by all students during the designated time periods. Both the essay and case study will be **open-book**, with no remote invigilation.

LEARNING OUTCOMES

The goal of this course is to introduce students to energy harvesting and conversion systems, energy delivery, and benefits and inefficiencies of different systems. The course will provide insight to energy consumption and geographical advantages and constraints of different systems.

By the end of this course, the students will be able to achieve the following **learning objectives** for the alternative energy systems covered in this course:

- Explain the scientific principles behind energy generation, distribution, storage and use
- Define energy and power, and compute conversion and efficiency
- Describe the current and emerging applications
- Discuss the environmental, resource and economic implications
- Discuss the policies that influence the implementation of these alternative energy systems

LEARNING MATERIALS

Required Textbooks

None

Other Course Materials

- Text book (optional): *Renewable Energy. Power for a Sustainable Future*, Godfrey Boyle, Oxford University Press, 3rd Edition. 2012.
- Access to additional learning materials, such as videos, reading materials and tools, will be provided by the instructors

LEARNING ACTIVITIES

Before each lecture

- Lecture topics may be supported by pre-lecture quizzes and suveys to gauge student's knowledge of topics to be discussed. Correct and incorrect answers will be identified during the lecture, but students will get full marks just for participating.

During each lecture

- Slides presentation: to cover the key concepts, theory and examples; serves as the basis for other learning activities
- In-class discussions: to create a group environment for students to share thoughts and work collectively on a given problem
- Polling (e.g., Sildo®, Padlet®): another activity to encourage the participation of students

After each lecture

- Extended learning materials: these *optional* learning materials include vidoes, short articles and exercises, which are intended for students to explore additional topics and gain knowledge beyond the content covered by the lecture.
- Assignments: for students to reinforce their learning outcomes and gauge their progresses.

Assignments for each week

Release time in a week	Purpose	Grading	Expected time to finish (min)	Submission deadline
After 2nd lecture	• Reinforce the learning outcomes • Self-assessment	Graded	60	By 11:59 pm on Sunday of the week
After 3rd lecture	• Prepare for portfolio (reflections on Canvas)	Graded after the final exam	30	Submission after the final exam

SCHEDULE OF LEARNING TOPICS

Note that all deadlines, dates and times are given in Pacific Standard Time (PST). Contact your instructors to discussion any adjustment needed to accommodate your time zone.

Start Week	Topics	Learning Activities	Assignment Dues
1 MWF (Jan.10-14)	• Discuss course syllabus • Meet your instructors and TA • Meet your classmates	• Review course introduction and overview materials. • Familiarize yourself with course platform and tools. • Ask any questions of general requirements for the course on class discussion board.	• Answer Pre-course survey in quizzes on Canvas (due by 11:59pm (PST) on Jan. 9).
	• Overview on fossil fuels (coal, oil and natural gas) • Brief on units and terminology	• Review the energy transition from coal to oil and to natural gas • Understand what drives the transition • Familiar with units used to decrsibe energy	
	• Understand why we need renewable energy • A glimpse to all sorts of renewable nergy	• Understand the need and drivers for renewable energy development	

		• Explain the pros and cons for each type of renewable energy	
Module 2: Solar energy			
2 MWF (Jan.17-21)	Basics of thermdynamics	• Review three laws of thermaldynamics • Learn the principles of heat engine and heat pump	
	Units conversions for energy and power	• Define units of energy and power • Understand unit conversions	Solar therm_HW
	Technical aspects of solar thermal energy	• Prototype and current applications • Scientific principles	
3 MWF (Jan.24-28)	Technical aspects of solar PV energy	• Prototype and current applications • Scientific principles	
	Sustainability aspects of solar PV energy	• Environmental implications • Economic implications • Policy support	Solar PV_HW
	Future of solar PV energy	• Emerging designs and challenges	
Module 3: Wind energy			
4 MWF (Jan.31-Feb.4)	Technical aspects of wind energy	• Prototype and current applications • Scientific principles	
	Sustainability aspects of wind energy	• Environmental implications • Economic implications • Policy support	Wind_HW
	Future of wind energy	• Emerging designs and challenges	
Module 4: Bioenergy and liquid fuels from biomass			
5 MWF (Feb.7-11)	What is bioenergy, types heat, biogass, biofuels, etc. what are the sources of biomass	• Variability and compostion of biomass • Examples where bioenergy is used • Differences between “traditional” and “advanced forms of bioenergy	
	Biomass supply chains	• What are the predominent forms of tradeable biomass? • What biomass is best suited for heat, energy, biogas, transport, etc. • Predisposition to heat and transport	Group assignment on one bioenergy topic
	Drop in biofuels	• What is a drop in biofuel?	

		• What sectors need drop in biofuels? • What policies are driving this? What are the alternatives?	
6 MWF (Feb.14-18)	Biodiesel/renewable diesel	• Feedstocks used to make biodiesel/renewabale diesel • Countries producing and using these fuels • Proceeeses use to make these fuels	
	Potential of co-processing to decarbonize oil refineries	• What is a typical oil refinery configuration? • What policies are driving stand alone biorefineries and co-processing • Feedstocks and possible insertion points	
	Mid-term exam		
Mid-term break: Feb.21-25 **(Mid-term essay due after the break)**			
8 MWF (Feb.28-Mar.4)	Role of enzymes in bioethanol production	• What are enzymes? • Where are they used in biofuel production? • Why have enzymes proved superior to alternatives such as acids/chemicals? • Enzyme nomencature	
	Ethanol from sugar and starch (conventional)	• Which countries produce and use ethanol for transport? • How is “conventioinal” ethanol” predominently made? • What drives ethanol use for transport?	
	Cellulosic ethanol	• What are the key steps in making cellulosic ethanol? • What forms of pretreatment might be used and predominate? • Examples of cellulosic ethanol plants • What are the challenges with making cellulosic ethanol?	Short essay
Module 5: Hydroelectric power			
9 MWF (Mar.7-11)	Technical aspects of hydroelectric power	• Prototype and current applications • Scientific principles	
	Sustainability aspects of hydroelectric power	• Environmental implications • Economic implications	Hydro_HW

		• Policy support	
	Future of hydroelectric power	• Emerging designs and challenges	
Module 6: Tidal and wave energy			
10 MWF (Mar.14-18)	Technical aspects of tidal energy	• Prototype and current applications • Scientific principles	
	Technical aspects of wave energy	• Prototype and current applications • Scientific principles	Tidal_wave_HW
	Sustainability and future development	• Environmental implications • Economic implications • Policy support • Emerging designs and challenges	
Module 7: Geothermal energy			
11 MWF (Mar.21-25)	Technical aspects of Geothermal energy	• Prototype and current applications • Scientific principles	
	Sustainability aspects of Geothermal energy	• Environmental implications • Economic implications • Policy support	Geotherm_HW
	Future of Geothermal energy	• Emerging designs and challenges	
Module 8: Energy storage and other alternative energy systems			
12 MWF (Mar.28-Apr.1)	Technical aspects of energy storage	• Introduce major types of energy storage systems • Scientific principles	Course feedback survey
	Sustainability and future development	• Environmental implications • Economic implications • Policy support • Emerging designs and challenges	Energy_store_HW
	Nuclear enegy	• Technical and sustainability aspects	
Module 9: Systems thinking and policy			
13 MWF (Apr.4-8)	Combine multiple energy systems to improve energy efficiency	Introduce major types of integrated energy systems	
	Introduction to energy policies	• Review major energy policies in Canada and gloablly • Introduction to Energy Policy Simulator (EPS) • In-class discussion using EPS	Policy_HW
	Sustainability and future development	• Environmental implications • Economic implications • Policy support • Emerging designs and challenges	Final case study released
Exam week			

14 (Apr.11-15)			Final case study due (**11:59 pm, Apr.15**)
			Course portfolio due (send link to instructor & TA) (**11:59 pm, Apr.20**)

ASSESSMENTS OF LEARNING

The course is evaluated through the **pre-lecture participations (e.g. surveys), post-lecture assignments, one midterm essay and one final case study**. The requirements of midterm essay and the final case study are at the same level of easiness as the examples shown in lectures and assignments. Both the essay and exam are open book and each is expected **to be completed within 5 calendar days after the release date**.

Assignments will be due at specific dates specified in Canvas. Late assignments will be penalized 10% of the total possible points for each day past the due date. Once the assignments are returned graded to the students, late assignments will automatically receive a grade of 10% but they still need to be handed in to pass the course. Students can not pass the course unless all assignments are submitted for grading, no matter how late they are. Grades will be allocated following the distribution below:

Assessments to student learning include the following components in this course. Each component must be passed to successfully complete the course and receive credits. The passing grade is 50%.

Components	Weight
Assignments	20%
Course participation	10%
Mid-term essay	30%
Final case study	40%
Course portfolio	+5%

Student final letter grade will be given based on the following:

Letter Grade	Percentage
A+	90% - 100%
A	85% - 89%
A-	80% - 84%
B+	76% - 79%
B	72% - 75%
B-	68% - 71%
C+	64% - 67%
C	60% - 63%
C-	55% - 59%
D	50% - 54%
F (Fail)	0% - 49%

Policies on Late Submissions and Re-grading

As per UBC policies, make-up tests, quizzes, or assignments will **only** be permitted in the case of extreme illness, which requires a doctor's note pertaining to that day, or death in the family, which also requires appropriate documentation.

Participation Expectations

Participation in the learning activities are required and will be evaluated based on the following:

- Submission of pre-lecture quizzes and surveys. 100% of the points will be awarded to students who complete the quizzes and surveys on time, regardless of how many correct answers. 0% of the points will be awarded for a late or missed submission
- Lecture attendance is required.
- Participation in interactive activities, such as in-class discussions and polling, is strongly encouraged.

DISCLAIMER

This pandemic has greatly altered teaching and studying at UBC, including changes to health and safety considerations. Keep in mind that some UBC courses might cover topics that are censored or considered illegal by non-Canadian governments. This may include, but is not limited to, human rights, representative government, defamation, obscenity, gender or sexuality, and historical or current geopolitical controversies. If you are a student living abroad, you will be subject to the laws of your local jurisdiction, and your local authorities might limit your access to course material or take punitive action against you.

UBC is strongly committed to academic freedom, but has no control over foreign authorities (please visit http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,33,86,0 for an articulation of the values of the University conveyed in the Senate Statement on Academic Freedom). Thus, we recognize that students will have legitimate reason to exercise caution in studying certain subjects. If you have concerns regarding your personal situation, consider postponing taking a course with manifest risks, until you are back on campus or reach out to your academic advisor to find substitute courses. For further information and support, please visit: https://academic.ubc.ca/support-resources/freedom-expression.

UNIVERSITY POLICIES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.

Code of conduct

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in total loss of points in an assignment, exam or entire course, and will be referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

To fully understand what plagiarism means and avoid it please visit:

http://learningcommons.ubc.ca/resource-guides/avoid-plagiarism/

For a broader guide on general student conduct, go to:

https://students.ubc.ca/campus-life/student-code-conduct

OTHER COURSE POLICIES

Learning Analytics

Learning analytics includes the collection and analysis of data about learners to improve teaching and learning. This course will be using the following learning technologies: Canvas. Many of these tools capture data about your activity and provide information that can be used to improve the quality of teaching and learning. In this course, I plan to use analytics data to:

- View overall class progress
- Track your progress in order to provide you with personalized feedback
- Review statistics on course content being accessed to support improvements in the course
- Track participation in discussion forums
- Assess your participation in the course

Copyright

All materials of this course (course handouts, lecture slides, assessments, course readings, etc.) are the intellectual property of the Course Instructor or licensed to be used in this course by the copyright owner.

- **Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline.**
- **Recording the lectures is prohibited**