CHBE 370
FUNDAMENTALS OF SUSTAINABLE ENGINEERING

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COURSE OUTLINE

1. Principles of sustainability and sustainable engineering (week 1)
   - Introduction to principles of sustainability, green chemistry, green engineering, sustainable engineering, pollution prevention, end-of-pipe treatment and systems thinking
   - Term paper guidelines

2. Environmental policies, laws and regulations (week 2)
   - Regional, national and global Air, water, soil and climate policies, laws and regulations
   Assignment #1

3. Life-cycle assessment (LCA) (weeks 3-4)
   - Methodologies of life-cycle assessment
   - Applications of life-cycle assessment
   - Audit and inventories
   - Process emissions, Fugitive emissions, Secondary emissions
   Case study 1: Life-cycle assessment of alternate fuel engine vehicles.
   Term paper proposal due

4. Environmental impacts and health risks (weeks 5-6)
   - Environmental impacts assessments
   - Health risk assessments
   - Integrated impact assessments
   Case study 2: Carbon footprint of British Columbia wood pellets
   Assignment #2.
   Quiz #1

5. Environmental cost and total cost analysis (weeks 7-8)
   - Environmental cost, external cost and total cost
   - Cost-benefit and cost-effectiveness analysis (environmental fees, penalties, carbon taxes, clean incentives, green subsidies)
   Case study 3: Cost-benefit and cost effectiveness analyses of BC AirCare program and residential heating.
   Assignment #3

6. Sustainability indicators for processes/products evaluation (weeks 8-9)
• Sustainability indicators and ranking criteria
• Evaluation and ranking methods
  ✓ Multi-objective (environmental-economic-social) optimization
  ✓ Pareto analysis, multiple perspectives
  ✓ stakeholder consideration

Case study 4: Evaluation and ranking of biomass residues to biofuels pathways in British Columbia

Assignment #4

7. Sustainable engineering in practice (weeks 10-12)
• Pollution prevention for unit operations
• Pollution prevention for industrial processes and products
  ✓ Sustainable design of processes
  ✓ Process water use/reuse
  ✓ Fugitive emissions
  ✓ Zero discharge
• Pollution prevention for industrial complexes and communities
  ✓ Industrial symbiosis
  ✓ Circular economy
  ✓ Water-food-energy nexus

Case study 5: A multi-scale approach for regional animal waste management

Quiz #2

8. Summary (week 12)

Term paper presentations (recorded videos) and peer review
Term paper submission

During this pandemic, the shift to online learning 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: http://academic.ubc.ca/support-resources/freedom-expression
Course schedule: 3 credit course, two 1.5-hour lectures per week plus one 2-hour tutorial every other week, starting week 2.

Marking scheme: 20% for 4 assignments, 10% for term project proposal, 10% for term project presentation, 30% for term paper, 30% for two quizzes

Assignment deadlines: completed assignments must be submitted online to the Canvas course website before 4:30 pm on the date they are due. Late assignments are penalized 10% of the maximum possible mark for each day or part day they are overdue. Assignments submitted after seven calendar days beyond the due date will not be marked and will automatically receive a score of 0%.

Course materials

Recommended textbooks

Important Journals on green and sustainable engineering
1. International Journal of Life Cycle Analysis
2. Journal of Cleaner Production
3. Journal of Industrial Ecology
4. Journal of Clean Products and Processes