

## ***ENBUS 406 – Industrial ecology: Sustainable materials***

Course outline fall 2019

**Instructor** Steven B. Young  
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**Office hours** Tuesdays 1-2 pm, EV3 4243  
**TA** Navya Nair  
**Class** Monday and Wednesday 11:30 am to 12:50 pm, room B2 350

### **Course description**

Sustainability of industrial materials is examined, including resources, production, use and end-of-life. Different types of industrial materials and major applications (buildings, transportation, communications, etc.) are covered. Industrial ecology and management approaches help restructure production systems and support sustainable development. The course will closely follow the textbook. Case studies focus on illustrative technology areas; however, the overall emphasis is management solutions for sustainable development.

### **Learning objectives**

After completion, you will be able to:

- Differentiate the importance and factors of raw materials, industrial production and impacts of use and end-of-life management in products, goods and services
- Apply approaches to manage environmental impacts of materials and products, including concepts of stocks and flows
- Apply life-cycle thinking to identify life cycle stages, impact hotspots for major product categories
- Frame discussions of renewable/non-renewable resources and technical/biological cycles
- Discuss circular economy concepts
- Use basic thermodynamics, mass/energy balance and systems thinking concepts
- Demonstrate quantitative skills for estimates, scale, rounding, significant figures, and units of measure.

### **Textbook**

Ashby, M. F. (2016). *Materials and sustainable development*. Oxford: Butterworth-Heinemann.

- Electronic book is available from the Waterloo library  
<https://www.sciencedirect.com/science/book/9780081001769>
- Paperback available

### **Modes**

Active and collaborative learning modes may include group exercises, role playing, case studies and gaming. Students are assigned in teams of 4-5 for the major assignment, which is supported by in-class mentoring from the instructor.

## Assessments

5% x 3	Assignments A1-A3 – quantities and calculations
15%	Case study – Group presentation in class
5%	Case study – Individual contribution to group work
5%	Peer evaluation of group presentations
5%	Participation including peer evaluations
30%	Midterm – focus on concepts and terms
25%	Final examination – IN CLASS

## Case studies

PRESENTATION BY	CORRESPONDING CHAPTER IN TEXTBOOK	PEER EVALUATION BY
Group 1: Biopolymers	8	Group 3 and 7
Group 2: Wind farms	9	Group 4 and 8
Group 3: Electric cars	10	Group 5 and 1
Group 4: Lighting	11	Group 6 and 2
Group 5: Solar PV	12	Group 7 and 3
Group 6: Bamboo	13	Group 8 and 4
Group 7: Air source heat pumps	None	Group 1 and 5
Group 8: TBD*	None	Group 2 and 6

See schedule for presentation dates.

\* Open topic subject to approval

## Readings

Several short readings will be assigned over the term.

## Schedule

WEEK		CONTENT	READINGS & ASSIGNMENTS
1	4-Sep	Course introduction Exercise	
2	9-Sep	Material history, categories	Chapter 1. Background: Materials, Energy and Sustainability, Sections 1.1-1.4
	11-Sep	Exercise	Chapter 2. What is a “Sustainable Development”?
3	16-Sep	The biggies	Chapter 1. Sections 1.5-1.7 <b>A1 due</b>
	18-Sep	Exercise	
4	23-Sep	Indicators: Energy	Chapter 3. Assessing Sustainable Developments: The Steps
	25-Sep	Exercise	
5	30-Sep	Indicators: GHG, water	Chapter 4. Tools, Prompts and Check-Lists <b>A2 due</b>
	2-Oct	Case	
6	7-Oct	Scarcity, supply chain risk	Chapter 5. Materials Supply-Chain Risk
	9-Oct	Exercise	
	14-Oct	<i>Thanksgiving Holiday</i>	
	16-Oct	<i>FALL BREAK – NO CLASS</i>	
7	21-Oct	Introduction to case studies	Chapter 7. Introduction to Case Studies <b>A3 due</b>
	23-Oct	Exercise	
8	28-Oct	Guest	
	30-Oct	<b>MIDTERM EXAM (in class)</b>	
9	4-Nov	Cradle to Cradle	Chapter 14. The Vision: A Circular Materials Economy
	6-Nov	Exercise	
10	11-Nov	<b>Groups 1 &amp; 2</b>	Chapter 8 & 9
	13-Nov	<b>Groups 3 &amp; 4</b>	Chapter 10 & 11
11	18-Nov	TBD	
	20-Nov	TBD	
12	25-Nov	<b>Groups 5 &amp; 6</b>	Chapter 12 & 13
	27-Nov	<b>Groups 7 &amp; 8</b>	
	2-Dec	Exam – in class	

## SEED grading expectations

Consistent with SEED policy, assessments are designed to provide fair evaluation of undergraduate performance and avoid grade compression.

Grade (%)	Qualitative description	Expected distribution
90+	Exceptional – in the sense that grades above 90 should be the exception and granted only where the student performance clearly exceeds the course expectations and shows full mastery of the subject matter of the course	10-20%
85 -90	Outstanding – demonstrates excellence and an insightful grasp of the subject matter. Marks here should be awarded to students that clearly exceed the expected performance in the course relative to other students.	
80-85	Excellent – demonstrates a strong grasp of subject matter in all or most areas of the course and ability to produce work of consistently high quality	60-80%
75-80	Very good – demonstrates strong grasp of subject matter across most areas of course and good or satisfactory knowledge in others, as well as ability to produce work above expected level.	
70-75	Good – demonstrates good knowledge of fundamental concepts and satisfactory understanding of more advanced ideas within course. Has ability to produce work at required level.	
65-70	Satisfactory – demonstrates basic understanding of fundamental concepts within course, but lacks advanced understanding of application. Inconsistent quality of work, but overall at required level.	10-20%
60-65	Minimally satisfactory – student achieves minimum expectations in most areas, and produces work that rarely exceeds minimal requirements	
50-60	Marginal performance – student demonstrates superficial grasp of subject matter in many areas of the course.	
Below 50	Fail	

## Course policies

- Submissions
  - Deadline is **11:59 pm** on due date. The LEARN time-stamp will be used.
- LEARN will accept one file per submission, will permit resubmits up to the deadline and will write over earlier files.
  - Plagiarism: originality of assignments may be checked using Turn-it-in.
  - References in APA.
  - Page numbers are required.
- An assignment that is late brings about an immediate 50% penalty. Assignments later than 5 business days will not be accepted and a grade of zero will be recorded.
- Returning assessments
  - The instructor will make every effort to return assignments directly to the student(s). In cases where this is not possible or impractical, assignments may be left in a public area for students to pick up. The instructor will:
    - Announce the method of returning assignments;
    - Allow students to make alternative arrangements;
    - Set a defined time limit, not to exceed two weeks, for which the assignments will be left in the public area.
    - Ensure the grade assigned is on the inside of the document.
- Remarking of assignments and tests
  - If you feel the need for review or remarking, submit your request for remarking on paper with a cover page attached to a complete printed copy of the assignment to the professor, including all comments, grading and feedback. Explain in detail what you feel needs to be addressed.
  - Requests for remark must be submitted within one (1) week of return of the assignment.
  - Submit your request directly to the professor, his office or into his SEED mailbox in EV3.
  - The professor will remark the contested work and the mark may increase or decrease.
- Requests for exemptions, medical or compassionate considerations are to be discussed with the professor in advance or as soon as possible.
  - If approved, the value of other assessments will normally be reweighted to accommodate the missed work.
  - Tests, midterms, quizzes or assignments will not be rescheduled to accommodate absence.

# Faculty and University Policies

**Unclaimed assignments:** Unclaimed assignments will be retained for a minimum of one year after term grades become official in QUEST. After that time, they will be destroyed in compliance with UW's confidential shredding procedures.

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [www.uwaterloo.ca/academicintegrity](http://www.uwaterloo.ca/academicintegrity). Students who are unsure what constitutes an academic offence are requested to visit the on-line tutorial at <http://www.lib.uwaterloo.ca/ait/>

**Research Ethics:** Please also note that the 'University of Waterloo requires all research conducted by its students, staff, and faculty which involves humans as participants to undergo prior ethics review and clearance through the Director, Office of Human Research and Animal Care (Office). The ethics review and clearance processes are intended to ensure that projects comply with the Office's Guidelines for Research with Human Participants (Guidelines) as well as those of provincial and federal agencies, and that the safety, rights and welfare of participants are adequately protected. The Guidelines inform researchers about ethical issues and procedures which are of concern when conducting research with humans (e.g. confidentiality, risks and benefits, informed consent process, etc.). If the development of your research proposal consists of research that involves humans as participants, the please contact the course instructor for guidance and see <http://iris.uwaterloo.ca/ethics/>

**Note for students with disabilities:** AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

**Mental Health:** The University of Waterloo, the Faculty of Environment and our Departments consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. Please note that help is available. Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services.

**Religious Observances:** A student needs to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please contact your Undergraduate Advisor for details.

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties, check Guidelines for Assessment of Penalties, [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm)

**Appeals:** A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 – (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

**Turnitin.com:** Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course.

**Communications with Instructor and Teaching Assistants:** All communication with students must be through either the student's University of Waterloo email account or via Learn. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

**Distribution of completed assignments:** Detail the method by which students can pick up marked assignments and for how long unclaimed assignments will be kept (see information below under, Additional steps to ensure a student's privacy is protected, for details on claiming assignments).

**Recording lectures:**

- Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course.
- If allowed, video recordings may only include images of the instructor and not fellow classmates.
- Posting of videos or links to the video to any website, including but not limited to social media sites such as: facebook, twitter, etc., is strictly prohibited.