Sustainability Education at HKUST

2020 Sustainability Course Evaluation Report

September 2020
Report developed by the Sustainable Education Advisory Group (SEAG)

As part of the HKUST 2020 Sustainability Challenge, the University included a commitment to ensuring that *all students gain a solid understanding of sustainability concepts and graduate with the capacity and commitment to solve problems locally and globally.*

This report documents the on-going efforts of the Sustainability Education Advisory Group (SEAG) to achieve this goal by assessing the breadth and depth of sustainability education across the curriculum at HKUST. This report includes:

1. Updated results of a preliminary evaluation of sustainability coverage across the 2019-20 UG course catalogue.
2. Updated results from a faculty self-assessment exercise; and,
3. Key findings and recommendations for moving forward.

Highlights from the report:

- Overall, Sustainability Focused or Related courses represent roughly 6% of the *overall* UG course catalogue.
- In 2019-20, Sustainability Focused or Related courses represented roughly 5% of the *approved new* courses.
- By distribution, all schools and most departments include at least one listed course. SENG has the largest overall number of listed courses among schools, and ENVR and CIVL have the greatest percentage of sustainability course offerings in 2019-2020.
- In terms of exposure to sustainability concepts, we note that 64% of recent graduates are leaving with a "strong" exposure (completing two or more Sustainability Focused courses); only 5% of students graduated with no course exposure to sustainability.

Course Criteria

As stated in the first Evaluation report in June 2018, the SEAG has undertaken several exercises to define the terms relating to sustainability, sustainability education, and sustainability courses. As a result, the SEAG has agreed that sustainability education is built through the interplay of:

- Relevant **knowledge and understanding** of the issues, supported by…
- An appreciation for **values and perspectives**, creating the foundation to build…
- The **skills and competencies** necessary to address the challenge of a sustainable future.

The SEAG also further developed a sub-list of criteria to help in evaluating core areas that are associated with sustainability education. The list of criteria is further broken down into key concepts, as detailed in Appendix A.

Values	**Knowledge and Understanding**	**Skills and Competencies**
1. Human responsibility within the environment 2. Human responsibility within society 3. Human behaviour	4. Natural limits 5. Business and economics 6. Science and technology 7. Planning and design 8. Governance	9. Systems thinking 10. Collaboration & communication 11. Futures thinking 12. Critical thinking & complex problem solving

Preliminary Evaluation

This 2020 edition is part of our annual exercise to update the sustainability course inventory. The purpose is to help us assess the breadth of sustainability education at HKUST. This review updates the findings based on the addition of newly offered courses in the 2019-2020 academic year.

The process starts with a preliminary review of keywords and concepts included in the course descriptions which may suggest sustainability content. Once the potential courses are identified in this preliminary review, the faculty members are contacted and asked to fill in a self-assessment survey to confirm the areas of content and the degree of attention dedicated to these sustainability concepts. The survey tool was developed based on the previously defined sustainability criteria, asking the faculty to provide detail information of which sustainability criteria their course would cover, and indicate the number of classes the sustainability concepts were covered.

In total, 43 newly offered courses were reviewed and seven courses were identified as potentially relevant to sustainability education.

After the self-assessment exercise, four new courses were added to the Sustainability course inventory, representing 5% of the newly offered course in the academic year of 2019-2020.

Determining Sustainability Breadth

To further evaluate the existing courses in the catalogue – and to help identify gaps and areas of opportunity – the SEAG decided to break the courses into two categories: "sustainability focused," and "sustainability related."

1. Sustainability focused courses – these courses may be broad and cover a wide breadth of sustainability concepts, content, issues, and contemporary thinking, or they may be narrowly focused and address one or more sustainability issues or concepts in depth. In both cases, the course is primarily focused on sustainability.
    - ✓ A focused course must concentrate on sustainability in **at least 75%** of class time, and incorporate elements of sustainability criteria within the course material (readings, discussions, and assignments).
2. Sustainability related courses – these courses are focused on a topic other than sustainability, but have sustainability ideas, principles, or content embedded within specific parts of the curriculum.
    - ✓ A sustainability related course spends **at least 25%** of class time covering one or more of the sustainability criteria within the course material (readings, discussions, and assignments).

Based on the results of the Self-assessment, the inventory was adjusted accordingly:

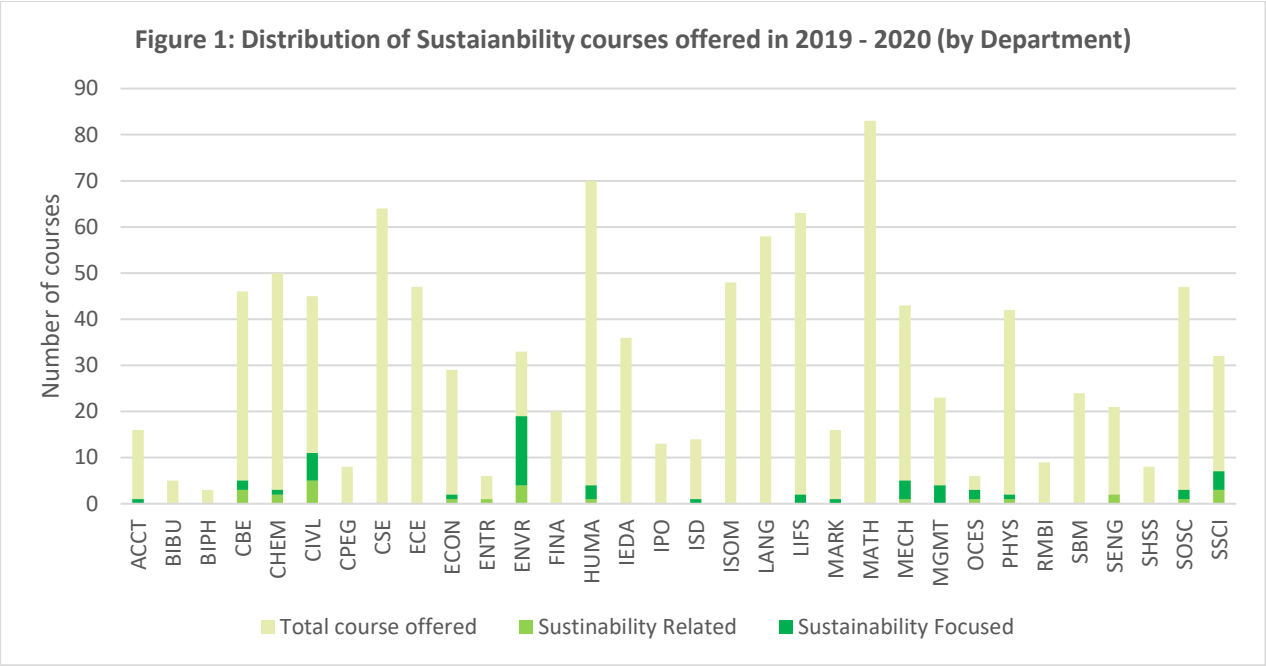
- Sustainability focused courses: 55 existing, plus 2 new in 2019-20 (57 total)
- Sustainability related courses: 29 existing, plus 2 new in 2019-20 (31 total)

The courses are distributed somewhat evenly by level (Table 1).

Table 1: Updated Sustainability Course Inventory (distribution by level)

	Sustainability Focused	Sustainability Related
1000 level	18	9
2000 level	17	4
3000 level	13	7
4000 level	9	11
TOTAL	57	31

In order to gain more insight, we then look into the distribution of sustainability courses offered in the academic year of 2019-2020 to see the distributions by department.

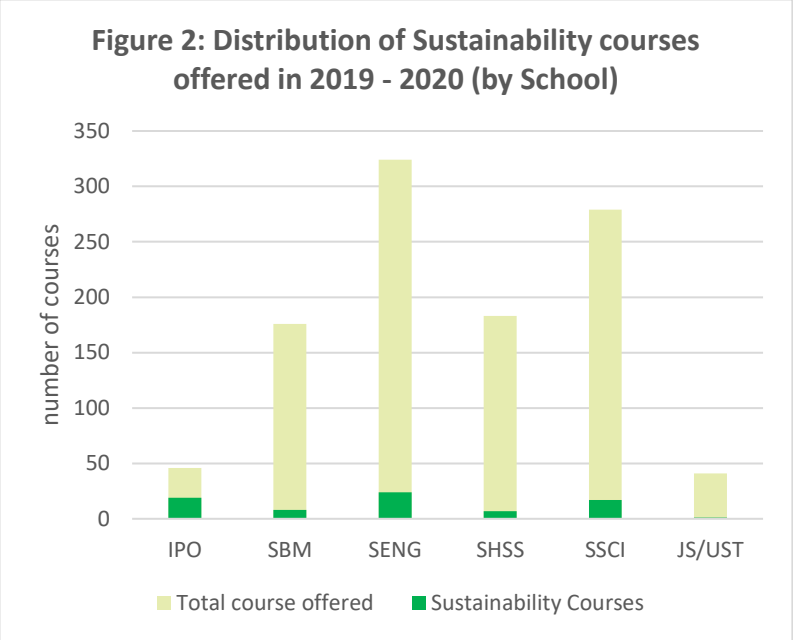


In the academic year of 2019 – 2020, a total of 1043 UG courses were offered. Out of which 76[1] courses were sustainability courses (7.3% of all the courses offered).

By department, ENVR and CIVL have the greatest percentage of sustainability course offerings in 2019-2020 (57.6% and 24.4% respectively). While 14 of the 32 departments (44%) offered no sustainability courses in 2019-20, they do list sustainability courses in their course catalogue.

[1] Excluding special topics courses, 8 sustainability focused, and 2 sustainability related courses were not offered in the academic year of 2019 – 2020. This may potentially be caused by some courses being cancelled due to the pandemic situation. According to the record from ARO, there were 52 sustainability courses in total offered in Spring 2019. However, in Spring 2020, there were only a total number of 46 sustainability courses offered.

By School, IPO has the greatest % offering of sustainability courses (41% of courses offered). The remaining Schools (excluding JS/UST) offer a range of 3.8%-7.1% of courses relevant to sustainability (Figure 2).



It is also noticeable that SENG offers the most courses that are related to sustainability (24 courses in total). However, with reference to Figure 1, we should note that 4 out of 9 course offering department under the school of engineering did not offer any sustainability courses in the academic year of 2019 – 2020, while most of the sustainability courses are offered by CIVL, CBE and MAE. This indicates that the exposure of sustainability education to engineering students may be dependent on their individual majors.

Evaluation of Sustainability Exposure

Similar to the previous report, with the help from ARO, we retrieved the enrolment data for the recent graduates (any students who graduated from 2019 Fall to 2020 Summer) and mapped those data against the 88 identified "sustainability focused" and "sustainability related" courses. The data was then analysed for the purpose of evaluating the level of exposure to sustainability concepts for students throughout their studies at HKUST.

In 2019/20 academic year, 2240 graduates (95%) enrolled in at least 1 sustainability course. Of those, 682 graduates (29% of all graduates) completed only 1 sustainability course. 64% of all graduates completed 2 or more Focused courses.

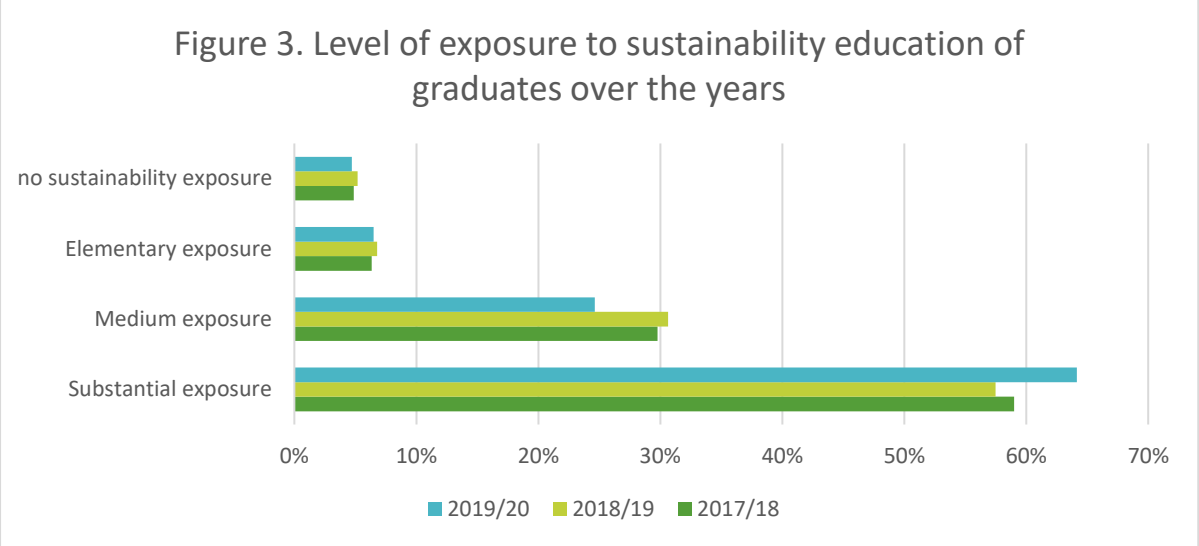
From this preliminary result, we can assume that at least 29% of graduates are gaining an elementary understanding of sustainability for 2019/20 academic year, while 67% are potentially gaining a medium to substantial exposure of sustainability concepts by taking two or more courses. And around 5% of students are potentially receiving little to no understanding or exposure to sustainability upon graduating—at least not in their coursework.[2]

We then analysed the data further to look at the level of exposure the graduates are receiving and to see whether there is any correlation or trend in the data.

[2] There are numerous other ways to gain exposure to sustainability concepts at HKUST; UST Connect, for example, provides activities and service learning opportunities that are aligned with UN Sustainable Development Goals (SDGs).

According to our previously defined designation, any courses that are listed as "sustainability focused" implies that over 75% of class time is dedicated to covering sustainability concepts, while "sustainability related" courses implies at least 25% of class time is spent on sustainability related concepts.

Based on this, we believe that for student to gain a strong exposure of sustainability concepts, a student should complete at least 2 "sustainability focused" courses. While students who only enrolled in "sustainability related" courses can be considered as having an elementary to medium exposure to sustainability.



In comparison to previous years, we can see that there are slightly more students completing 2 or more sustainability focused course (Figure. 3), thus receiving a substantial exposure of sustainability concepts from the graduates of 2019/20 academic years (64%) in comparison to graduates of 2017/18 (59%) and 2018/19 (57%).

The figure also clearly shows that for graduates that received no sustainability exposure (did not complete any sustainability courses) and those that received an elementary exposure, there is not much difference over the years. This indicates that while there are is an increase in number of students taking more sustainability courses, we may need to focus more on engaging the students that are receiving little to no sustainability concepts.

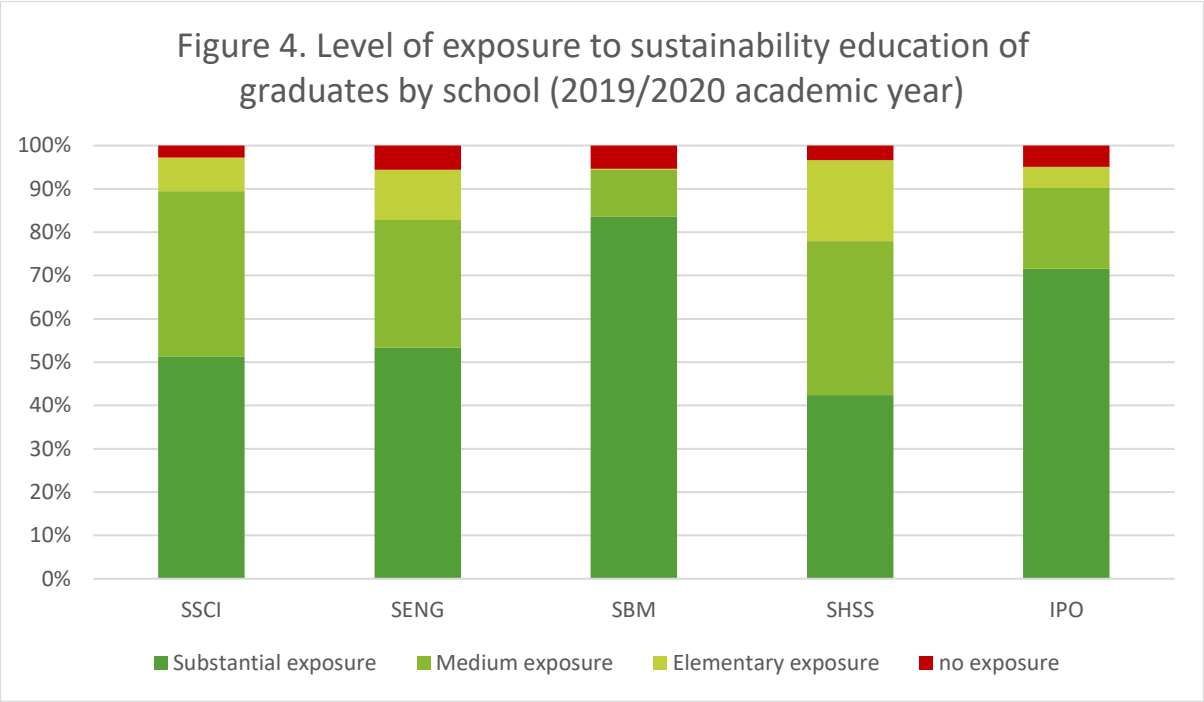


Figure 4. shows the exposure level of the graduates to sustainability education by school for the academic year of 2019/20.

It is apparent that IPO and SBM have higher percentages of graduates with strong exposure to sustainability education than the other schools (71.56% and 83.55%). While graduates from SBM also have the least percentage of graduates with elementary exposure (0.24%), indicating that a high proportion of SBM graduates gained medium or substantial exposure of sustainability education during the course of their study (94.39%).

Out of all the schools, SHSS has the least percentage of graduates with substantial exposure (42.37%) while they have the highest percentage of graduates with only elementary exposure (18.41%).

Compared to last year, the percentage of graduates of SENG students with no exposure dropped from 8.2% to 5.5%, although it still has the highest percent of graduates with no exposure to sustainability. This means overall no school has more than 5.5% graduates that did not take a single sustainability course.

The overall result shows that this is short of the University's 2020 education goal of ensuring that *all students gain a solid understanding of sustainability concepts*. The result suggested a high percentage of graduates are receiving medium to substantial exposure to sustainability concepts, and there is an increase in the students taking more sustainability courses. However, it is also apparent that the percentage of graduates receiving no exposure remain much or less the same. Our next target is to reach all the students.

Conclusion and recommendation

As suggested in the previous report, the assessment result demonstrates that sustainability ideas and concepts are permeating across all schools and in many departments. It is also suggested the

level of sustainability education exposure depends heavily on a student's major or which school they are in.

In addition, this shows that there is clear work still needed to ensure that *all students* graduate with a solid understanding of sustainability concepts.

In order to meet the university's 2020 education goal, we would recommend the following four initiatives for reaching a higher level of sustainability literacy.

1. ***Develop a branding system for easily identifying sustainability coursework.***

   By developing a branding scheme for distinguishing the sustainability-focused in the course catalogue, we can enable the students to identify sustainability easily and quickly for designing their own sustainability learning pathway.

   A branding scheme would also act as an incentive for faculty to (a) complete the self-assessment, and (b) adjust their course materials in order to qualify for a designation, thus contributing to the university education goal.

2. ***Promote the new Sustainability Minor as a way for interested students to supplement their studies with a more structured framework for understanding sustainability within the context of skills, values, and knowledge.***

   As the previous report concluded, the result of the assessment exercise indicated that there was sufficient breadth and depth of coursework to support an academic minor that is cross-disciplinary. That new minor was approved during the 2019/20 academic year, and students are now eligible to take part. The sustainability minor was designed to provide a more structured framework for interested students to create their own learning pathway that is most suitable for their personal interests. It is also be an incentive for students that they can pursue their interest in sustainability for a minor as a recognition.

3. ***Identify more non-curricular pathways for students to gain knowledge of sustainability concepts.***

   The new Sustainable Smart Campus as a Living Lab (SSC) provides multiple chances for students to test new ideas and gain hands-on experience in developing projects that can be implemented on campus. These projects reinforce many of the sustainability concepts by allowing students to think about solving problems on campus that are directly connected to broader global sustainability challenges.

Appendix A: Sustainability Criteria

	Criteria	Key Concepts
VALUES	**Human responsibility within the environment** *Exploring the morality underlying how humans interact with natural surroundings, particularly through the lens of fairness and responsibility for future generations*	• Environment-related Sustainable Development Goals • Environmental justice • Valuing eco-system services for future generations • Ecological citizenship in terms of protection of the public environmental good • Appreciation, empathy, and nurturing of environmental values
	Human responsibility within society *Exploring the social factors that limit human thriving and global quality of life*	• Social justice and responsibility • Social-focused Sustainable Development Goals • Universal Declaration of Human Rights • Poverty reduction • Equity (e.g., income distribution, Gini coefficient) • Gender equality • Actions that degrade human well-being
	Human behaviour *Exploring how culture, social networks, and personal identity can shape human behaviours in ways that impact our ability to act in sustainable ways*	• Institutional theory and dynamics of social change • Behaviour economics • Change management • Strategies for pro-environmental behaviors (e.g., Community-Based Social Marketing) • Environmental psychology • Reflecting upon diverse perspectives (e.g., moral relativism, social norms, identities)
KNOWLEDGE	**Natural limits** *Exploring the finite capacity of natural ecosystems (including the global ecosystem) and their ability to support human needs*	• The Anthropocene • The biosphere, ecological risks, biodiversity • Understanding of planetary systems (air, water, or soil) • Food systems • Demographic trends • Natural capital and limits to growth
	Business and economics *Exploring the market conditions that create "market failures" with respect to the environment or society, and examining business and economic strategies that can better maintain the integrity of ecosystems*	• The circular economy • Sustainability business strategies (e.g., auditing, reporting, green finance) • Tragedy of the commons, externalities, or other market failures • Global patterns of production and consumption
	Science and technology *Exploring the role of basic science and technology (broad and individual technologies) specifically in mitigating harmful impacts to humans and the natural world*	• Transitions to renewable, zero-carbon energy • Green technologies to preserve oceans, forests, and agriculture • Technologies to generate efficiency, conservation, and productivity • Mitigating pollution, waste, and effluence • Smart cities strategies
	Planning and design *Exploring concepts from local and regional planning, infrastructure development, and*	• Sustainable urban environments • Green building design • Product design for sustainability outcomes • Urban infrastructure (e.g. transport, waste management)

	product design to mitigate harmful impacts to humans and the natural world	
	Governance *Exploring how legal frameworks and government policies impact society and the natural world*	• Political and economic organisations • Policy for sustainability (e.g., codes, standards, and regulations) • Governing for public good (e.g., public investment, incentives, public relations campaigns) • Legal frameworks (e.g., property rights, trade agreements)
SKILLS	**Systems thinking** *Building a holistic perspective, recognising interconnectedness and interdependence across multiple scales*	• Resilience and robustness • System dynamics (e.g., feedback loops, tipping points) • Unanticipated consequences and trade-offs • Qualitative / quantitative systems analysis • Life-cycle thinking and whole-life cost analysis
	Collaboration & communication *Building interdisciplinary thinking and a capacity to work with others to resolve sustainability problems*	• Communicating for sustainability outcomes • Negotiation, mediation, or conflict resolution • Team-building for sustainability causes • On/off-site experiential learning • Stakeholder engagement
	Futures thinking *Building an orientation to the long-term, with the ability to anticipate future challenges, risks, and opportunities*	• Assessing sustainability-related risks • Forecasting / backcasting • Scenario planning • Simulation modelling • Strategic planning • Adaptation and mitigation strategies
	Critical thinking and complex problem-solving *Building a foundation for evaluating the credibility of data and ideas, and the capacity to develop and implement meaningful solutions*	• Analysis of news cycles and media depictions of events • Objective development of judgements and persuasive arguments • Principled reasoning • Multi-criteria assessment models • Impact assessment methods • Creativity and innovation • Critical data analysis and interpretation

Appendix B : Updated sustainability courses

SUSTAINABILITY FOCUSED		SUSTAINABILITY RELATED	
CENG4130	Plant Design and Economics	ACCT1010	Accounting, Business and Society
CENG4720	Environmental Impact Assessment and Management Systems	CENG3230	Reaction and Reactor Engineering
CENG4912	Chemical and Environmental Engineering Project	CENG4710	Environmental Control
CHEM1004	Chemistry in Everyday Life	CHEM4310	Environmental Chemistry
CIVL /ENVR1150	Climate Change Impacts and Extreme Weather Events	CHEM4320	Environmental Analytical Chemistry
CIVL1140	Environmental Quality Control and Improvement	CIVL1160	Civil Engineering and Modern Society
CIVL1170	Big History, Sustainability and Climate Change	CIVL2410	Environmental Assessment and Management
CIVL3420	Water and Wastewater Engineering	CIVL3610	Traffic and Transportation Engineering
CIVL3510	Hydrosystems Engineering	CIVL4100H	Water, Energy and Climate Challenges in Smart Cities
CIVL4450	Carbon Footprint Analysis and Reduction	CIVL4440	Environmental Systems Analysis
CIVL4460	Process Design of Environmental Engineering Facilities	CIVL4620	Transportation System Operations
ECON4434	Economic Development and Growth	ECON2310	Introductory Environmental and Health Economics
ENTR3030	Social Innovations & Entrepreneurship	ENEG/MECH3110	Materials for Energy Technologies
ENVR 3010O	Sustainable Urban Development and Responses to Climate Change	ENGG1110	Engineering Solutions to Grand Challenges of the 21st Century
ENVR/SOSC2310	Introductory Environmental and Health Economics	ENGG1130	The Impact and Value of Technology Innovation
ENVR1030	Environment and Health	ENGG2990J	Systems Design Engineering
ENVR1040	The Environment and Society - A Comprehensive Perspective	ENTR 1001	Entrepreneurship 1001: Building Your Own Future
ENVR1050	The Sustainable Citizen	ENVR3220	Energy Resources and Usage
ENVR1070	Thinking Big: Systems Thinking for Environmental Problems	ENVR4000O	Climate Modelling and Risk Assessment
ENVR1080	The Smart Consumer - Uncovering the Hidden Story behind the Product Label	ENVR4320	ESG Management and Reporting
ENVR2002B	Life Cycle Analysis	ENVR4330	Environmental Geographical Information System
ENVR2010	Environmental Science Fundamentals	ENVS3004	Global Climate Change
ENVR2020	Urban Air Pollution	ENVS4001	Environmental Impact and Risk Assessment
ENVR2040	Life Cycle Assessment	ENVS4905	Marine Molecular Biology and Ecology
ENVR2050	Sustainability Thinking	IELM2150	Product Design

ENVR3003	Green Buildings and Energy Efficiency
ENVR3010G	Sustainability Thinking
ENVR3110	Sustainable Development
ENVR3310	Green Business Strategy
ENVR3410	Economics for Environmental Policy and Management
ENVS2001	Environmental Conservation and Sustainability in Practice
ENVS2004	Introduction to Ocean Science
ENVS4301	Environmental Conservation
HUMA2595	Science, Technology and Modern Life
HUMA2597	Environmental History
HUMA2621	Culture and Environment
HUMA2623	Cultural Sustainability in South China
ISOM1700	Critical Issues in Business Operations
LIFS/OCES2011	A Practicum on Wetland Conservation
LIFS1030	Environmental Science
MARK1220	Marketing and Society
MECH1902	Energy Systems in a Sustainable World
MECH1905	Buildings for Contemporary Living
MECH1906	Mechanical Engineering for Modern Life
MECH4350	Indoor Air Quality in Buildings
MGMT2010	Business Ethics and the Individual
MGMT2130	Business Ethics & Social Responsibility
MGMT3160	Environmental Business Strategies
MGMT3170	Managing CSR (Corporate Social Responsibility)
PHYS1003	Energy and Related Environmental Issues
SOSC1860	Population and Society
SOSC2170	Environment, Sustainability and Business: A Design Approach
SOSC3260	Sustainability Science: Problems and Perspectives
SOSC3540	Psychology of Environmental Sustainability
MECH3420	Engineering Materials II
OCES 1001	The Earth as a Blue Planet
PHYS1001	Physics and the Modern Society
SCIE1120	Chemistry and Life
SOSC3880	Social Inequality and Social Mobility
HUMA 1000E	Cultures and Values: Freedom, Justice, and the Good

SOSC4290	China's Sustainable Development
SUST1000	Introduction to Sustainability
ISDN 2200	Systems Thinking and Design