Sustainability Education at HKUST

2022 Sustainability Course Evaluation Report

October 2022
Report developed by the Sustainable Education Advisory Group (SEAG)

The strategic vision for HKUST is to become a regional leader in sustainability education with a global outreach. As an on-going effort to achieve the Sustainable education goal of ensuring that *all students gain a solid understanding of sustainability concepts and graduate with the capacity and commitment to solve problems locally and globally*, The Sustainability Education Advisory Group (SEAG) has been conducting this analysis annually since 2018 to identify opportunities and gaps in the existing provision of sustainability-relevant courses, providing a basis for the development of sustainability education across Schools and programs.

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

1. Updated results of the sustainability coverage across the 2021-22 UG course catalogue;
2. Updated sustainability course inventory; and,
3. Key findings and recommendations for moving forward.

Highlights from the report:

- In 2021-22, Sustainability Focused or Related courses represented roughly 7.8% 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 are the departments with the greatest percentage of sustainability course offerings in 2020-2021.
- In terms of exposure to sustainability concepts, we note that 66% 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, which remains consistent with the last years.

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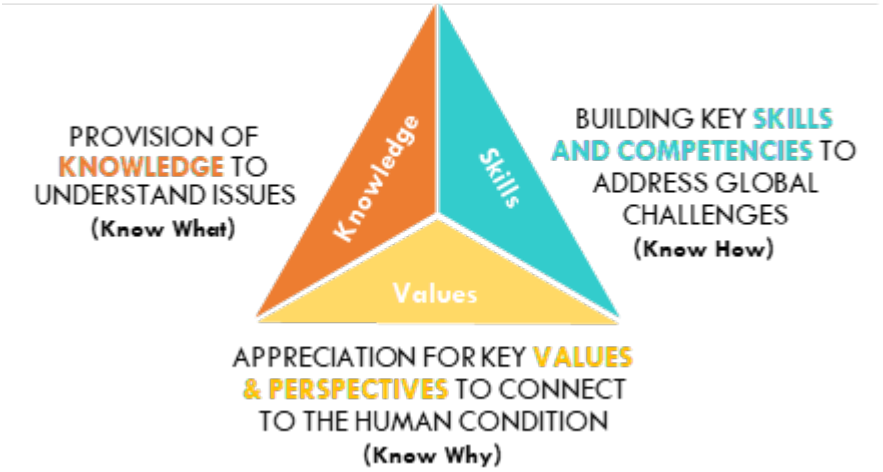
Course Criteria

Sustainability education is the foundation for preparing students to meet the challenge of *sustaining human thriving over time and within planetary boundaries*. As documented in the first Evaluation report in June 2018, SEAG has undertaken several exercises to define the terms relating to sustainability, sustainability education, and sustainability courses.

SEAG 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

Figure 1: Sustainability Education Framework



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

Sustainability course inventory update

As an on-going effort for assessing the breadth and depth of sustainability education across the curriculum at HKUST, we have evaluated all our existing undergraduate courses against the list to develop a sustainability course inventory. This report will provide an update on the annual exercise to add the newly available sustainability courses to the course catalogue for the academic year 2021–2022.

Preliminary Evaluation

The evaluation process starts with a preliminary review which includes identifying any keywords or concepts in the course descriptions which suggest the course may cover sustainability concepts throughout its delivery. Apart from courses that had keywords in their description which overlap with the pre-defined sustainability course criteria, courses which has no overlap in wordings but the descriptions itself suggested that it may be sustainability related were also shortlisted for further investigation.

Faculty Self-Assessment Exercise

In order to assess the shortlisted courses and ensure they are properly designated as "sustainability focused" or "sustainability related" courses, each course instructor is invited to complete a self-assessment survey which asks them to provide detailed information of their courses. The survey is developed based on the previously defined sustainability criteria and helps clarify how much class time is dedicated to teaching sustainability concepts.

The courses are separated 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).

A total of 77 newly offered courses were reviewed and an addition of six new courses were added to the Sustainability course inventory, representing 7.8% of the newly offered course in the academic year of 2021-2022.

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

	Sustainability Focused	Sustainability Related
1000 level	18	9
2000 level	18	4
3000 level	14	10
4000 level	12	13
TOTAL	61	36

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

Evaluation of Sustainability Exposure

With the help from ARO, we retrieved the enrolment information for recent graduates (defined as any students who graduated between the fall of 2021 and the summer of 2022), and we mapped that information against the 97 courses that were identified as "sustainability focused" and "sustainability related." The information was then examined in order to determine how much exposure students at HKUST had to sustainability principles.

In the academic year of 2021/22, 2,358 graduates (94.5%) had enrolled in at least 1 sustainability course during their undergraduate studies. Of those, 717 graduates (28.7% of all graduates) completed at least 1 course that is related to Sustainability. 1,641 graduates (65.8% of all graduates) completed 2 or more Sustainability Focused courses.

Based on this preliminary result, we can assume that at least 28.7% of graduates are potentially gaining an elementary understanding of sustainability, while ***65.8% 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.[1]

Any courses that are classified as "sustainability focused" mean that more than 75% of class time is devoted to covering sustainability ideas, while courses that are listed as "sustainability related" imply that at least 25% of class time is devoted to covering sustainability related topics.

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 completed less or only enrolled in "sustainability related" courses can be considered as having an elementary to medium exposure to sustainability.

[1] 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). There are also many UROP projects that are related to sustainability which are not included in this analysis.

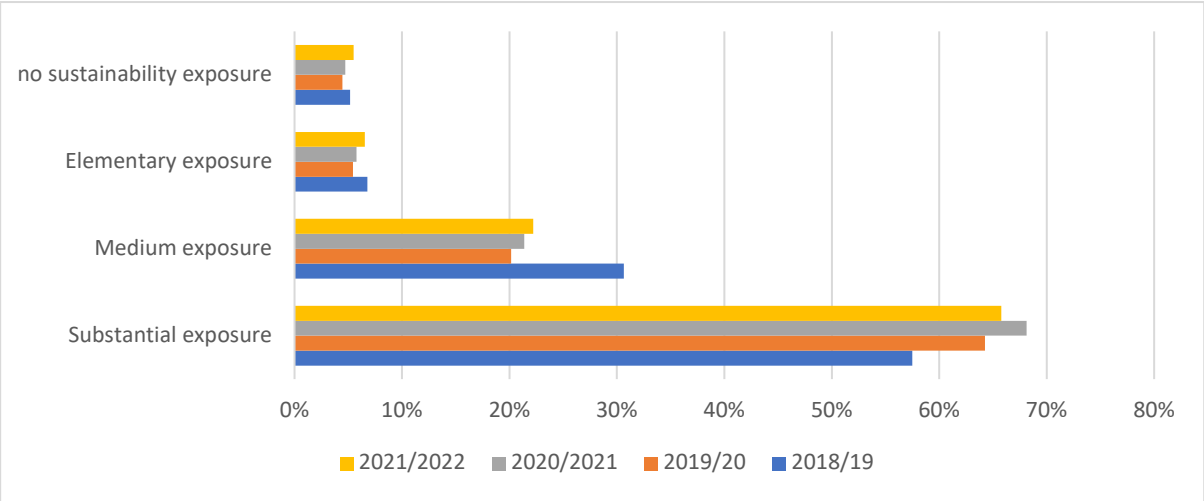


Figure 4. Level of exposure to sustainability education of graduates over the years

According to figure 4, it is apparent that the since the academic year of 2018/19, there has been minimal changes in the overall distributions of exposure to Sustainability.

While it is reassuring that there is abundance of sustainability concepts dispersed in the UG curriculum, we should also target the students that are receiving little to no sustainability concepts.

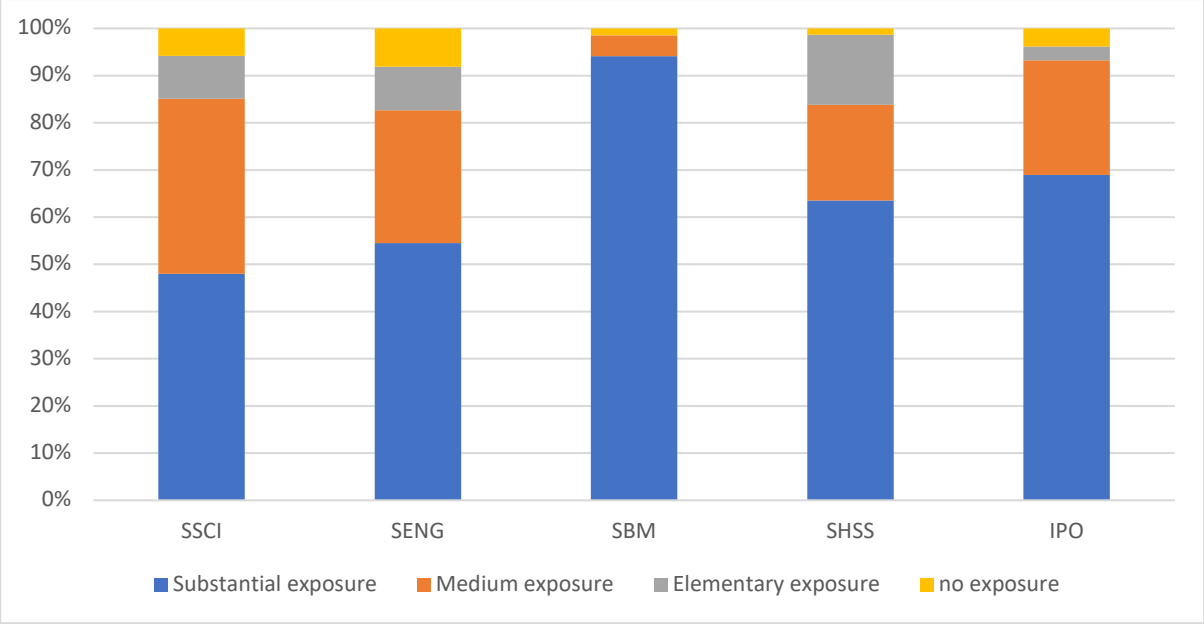


Figure 5. Level of exposure to sustainability education of graduates by school (2020/2021 academic year)

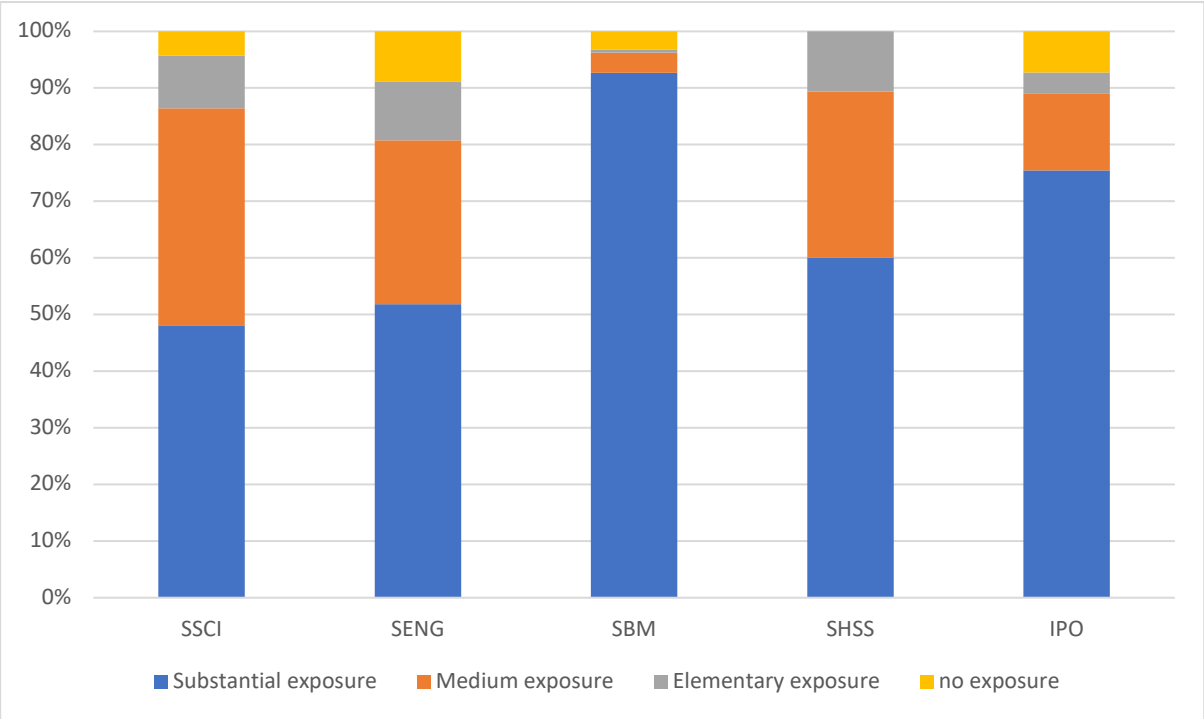


Figure 6. Level of exposure to sustainability education of graduates by school (2021/2022 academic year)

With reference to figure 5 & 6, it is apparent that for both 2020/2021 and 2021/2022 academic year, SBM (94.1% & 92.7% respectively) has the highest percentage of graduates with substantial exposure to sustainability in comparison to the other school for both academic years, followed by IPO (68.9% & 75.5%) and SHSS (63.5% & 60.0%)). While both SBM and SHSS have the least percentage of graduates with no exposure.

By comparing the result of the two academic years, it is evident that the there is no major changes in the pattern, which heavily implies that the students' study pathway is heavily influenced by their major.

Conclusion and recommendation

The overall result shows that a high percentage of graduates are receiving medium to substantial exposure to sustainability concepts. However, a small portion of graduates are still graduating with no exposure to sustainability. Additionally, we saw that in SENG and SSCI, the percentage of students with various levels of exposure did not significantly differ from the outcome from the previous report, indicating that more effort is required to raise those students' exposure to sustainability.

Furthermore, this demonstrates that there is clear work still needed to ensure that *all students* graduate with a solid understanding of sustainability concepts. In the long term, we should continue to discuss about how we may potentially evaluate the performance and integrate elements like planned learning outcomes into the analysis.

We would suggest the following four activities to achieve a greater level of sustainability literacy in order to accomplish the university's primary educational purpose.

1. ***Continue implementing a sustainability literacy test on an annual basis.***

As concluded in the report, while this annual exercise is exceptionally effective for us to assess the exposure of sustainability education to students before they graduate from HKUST, it does not give us a clear picture of how well the students are understanding these concepts. As an effort to gain a better understanding of the sustainability literacy of students, SEAG has developed a survey, called the "Sustainability literacy test", which comprise of 18 multiple-choice questions that cover different aspects of sustainability.

The first trial was conducted in Spring 2021 and invited students from all school to participate on a voluntary basis. The survey was implemented in Spring 2022, and we plan to implement the test on an annual basis to look at results in a longitudinal study. It also gives us a much clearer picture of how well the students are understanding the sustainability concepts, rather than just being exposed to it.

2. ***Investigate ways to capture sustainability learning from outside the classroom***

Leaning is increasingly happening outside of the classroom and experiential learning opportunities can provide excellent foundations for learning about sustainability concepts and approaches. While difficult, it will be important to assess the impact on understanding sustainability from activities such as sustainability-centred student societies, service learning, or participation in hackathons or student competitions.

3. ***Continue to implement sustainability learning elements in the Sustainable Smart Campus as a Living Lab***

The SSC now has expanded to include several pathways for students to engage in hands-on sustainability work in ways that use our campus as a "living lab" for testing new ideas and approaches. In addition, the SSC has an opportunity to use the Hub (video wall next to Passion) as an educational resource so that students can learn about specific topics as they walk through the Concourse.

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

	product design to mitigate harmful impacts to humans and the natural world	• Urban infrastructure (e.g. transport, waste management)
	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 *(Newly added courses this year are highlighted)*

SUSTAINABILITY FOCUSED		**SUSTAINABILITY RELATED**	
CENG4130	Plant Design and Economics	ACCT1010	Accounting, Business and Society
CENG4720	Environmental Impact Assessment and Management Systems	CENG3150	Integrated Chemical Process and Product Design
CENG4912	Chemical and Environmental Engineering Project	CENG3230	Reaction and Reactor Engineering
CHEM1004	Chemistry in Everyday Life	CENG4710	Environmental Control
CIVL/ENVR1150	Climate Change Impacts and Extreme Weather Events	CHEM4310	Environmental Chemistry
CIVL1140	Environmental Quality Control and Improvement	CHEM4320	Environmental Analytical Chemistry
CIVL1170	Big History, Sustainability and Climate Change	CIVL1160	Civil Engineering and Modern Society
CIVL3420	Water and Wastewater Engineering	CIVL2410	Environmental Assessment and Management
CIVL3510	Hydrosystems Engineering	CIVL3610	Traffic and Transportation Engineering
CIVL4450	Carbon Footprint Analysis and Reduction	CIVL4100H	Water, Energy and Climate Challenges in Smart Cities
CIVL4460	Process Design of Environmental Engineering Facilities	CIVL4440	Environmental Systems Analysis
ECON4434	Economic Development and Growth	CIVL4620	Transportation System Operations
ENTR3030	Social Innovations & Entrepreneurship	ECON2310	Introductory Environmental and Health Economics
ENVR/SOSC2310	Introductory Environmental and Health Economics	ENEG 4210	Optimization of Energy Systems
ENVR1030	Environment and Health	ENEG/MECH3110	Materials for Energy Technologies
ENVR1040	The Environment and Society - A Comprehensive Perspective	ENGG1110	Engineering Solutions to Grand Challenges of the 21st Century
ENVR1050	The Sustainable Citizen	ENGG1130	The Impact and Value of Technology Innovation
ENVR1070	Thinking Big: Systems Thinking for Environmental Problems	ENGG2990J	Systems Design Engineering
ENVR1080	The Smart Consumer - Uncovering the Hidden Story behind the Product Label	ENTR1001	Entrepreneurship 1001: Building Your Own Future
ENVR2002B	Life Cycle Analysis	ENVR3220	Energy Resources and Usage
ENVR2010	Environmental Science Fundamentals	ENVR4000O	Climate Modelling and Risk Assessment

ENVR2020	Urban Air Pollution	ENVR4320	ESG Management and Reporting
ENVR2040	Life Cycle Assessment	ENVR4330	Environmental Geographical Information System
ENVR2050	Sustainability Thinking	ENVS3004	Global Climate Change
ENVR2060	**From Trash to Treasure: Managing Waste to Resources**	**ENVR4010D**	**Independent Study in Environment Issues**
ENVR3003	Green Buildings and Energy Efficiency	ENVS4001	Environmental Impact and Risk Assessment
ENVR3010G	Sustainability Thinking	ENVS4905	Marine Molecular Biology and Ecology
ENVR3010O	Sustainable Urban Development and Responses to Climate Change	HUMA1000E	Cultures and Values: Freedom, Justice, and the Good
ENVR3110	Sustainable Development	IELM/IEDA2150	Product Design
ENVR3310	Green Business Strategy	MECH3420	Engineering Materials II
ENVR3410	Economics for Environmental Policy and Management	OCES1001	The Earth as a Blue Planet
ENVR4470	**Air Quality Control and Management**	**OCES3201**	**Biological Oceanography**
ENVS2001	Environmental Conservation and Sustainability in Practice	PHYS1001	Physics and the Modern Society
ENVS2004	Introduction to Ocean Science	PPOL3210	Energy Policy
ENVS4301	Environmental Conservation	SCIE1120	Chemistry and Life
FINA4929Q	**Responsible Finance**	SOSC3880	Social Inequality and Social Mobility
HUMA2595	Science, Technology and Modern Life		
HUMA2597	Environmental History		
HUMA2621	Culture and Environment		
HUMA2623	Cultural Sustainability in South China		
ISDN2200	Systems Thinking and Design		
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
MECH4000N	Solar Energy Conversion Technology
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
SOSC4290	China's Sustainable Development
SUST1000	Introduction to Sustainability

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