

Academic Year	2021/2022	Semester	2
Course Coordinator	Joyce Ong		
Course Code	ES1007/CY1007		
Course Title	Climate Change		
Pre-requisites	None		
No of AUs	3		
Contact Hours	Lectures: 13 x 2 hours = 26 hours Tutorial: 13 x 1 hour = 13 hours		
Proposal Date	11 October 2021		

Course Aims

Students will be expected to demonstrate a clear understanding of relevant concepts drawn from the Earth sciences, chemistry, physics, engineering, economics, social and political science, and be able to explain the relevance of these concepts for our present understanding of human-caused climate change and for the viability of different proposed solutions.

Intended Learning Outcomes (ILO)

By the end of this course, you should be able to:

- 1) Explain and evaluate the evidence for human-caused climate change in the context of historical climate change.
- 2) Explain and quantify the impacts of climate change on human well-being and the natural world.
- 3) Evaluate options for reducing emissions (mitigation) and reducing the impacts of climate change (adaptation).
- 4) Critically evaluate the successes and failures of past national and international efforts to address climate change and evaluate prospects for future management of climate change.
- 5) Apply the knowledge gained by successfully communicating science and ideas to a broader audience.

In completing this course, you will improve your ability to read and understand research papers from several disciplines addressing climate change. You will also improve your ability to communicate through a video essay, and to develop and test hypotheses through an individual research paper.

Course Content

Climate change is a difficult, contentious and important issue. It will perhaps be the defining environmental issue of the 21st Century. This course aims to address the whole complexity of climate change as an issue, by bringing together the science, impacts, economics, abatement technologies, and policy solutions into one course. Through this course, we will address several important questions. What is the scientific basis for our understanding of climate change, and in what ways is that scientific basis uncertain? What changes in climate might we expect over the coming centuries? What would be the impacts of these changes in climate for human well-being and the natural world? What are the sources of emissions of greenhouse gases? What are the social science aspects of climate change? What technologies exist or might be developed to allow us to slow climate change, and what international policy solutions might be necessary or preferred?

Assessment (includes both continuous and summative assessment)

Component	ILO Tested	Related program LO or Graduate Attributes (Appendix 1)	Weighting	Team/Individual	Assessment Rubrics
1. Tutorial participation	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6	5%	Individual	Appendix 2
2. In-class quiz (10 MCQ)	1, 2, 3, 4, 5	1, 3, 4, 5	10%	Individual	
3. Group assignment	1, 2, 3, 4	1, 2, 3, 4, 5, 6	40%	Team	Appendix 3
4. Research paper (first draft, peer-graded)	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6	5%	Individual	Appendix 4
5. Research paper (final draft)	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6	35%	Individual	Appendix 4
6. Grade peer feedback for first draft of research paper	3, 5	1, 2, 4, 5	5%	Individual	Appendix 5
Total			100%		

Formative feedback

There will be informal feedback continuously throughout the course where appropriate. Some of the assignments are based on peer feedback, and feedback will be given following the group and research paper assignments. Additionally, the TA's and myself will be willing to answer questions throughout the course.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Active learning	Students will have opportunities to engage in active learning periodically throughout lectures and during tutorial sessions.
Independent learning	Students are required to be self-motivated and show initiative throughout the course, for example in group discussions, peer learning, preparations for tutorials and group work assignments.

Reading and References

Because climate change is a rapidly evolving study, this course will make use of recent and primary sources in the literature, drawing heavily from some of the key articles in journals such as *Science* and *Nature Climate Change*. We will also use significant portions of the Intergovernmental Panel on Climate Change reports. Full text of these reports is available online at www.ipcc.ch.

The US National Climate Assessment reports (<https://science2017.globalchange.gov/>).

Also, older reports are available from the US Global Change Research Program, including the “Synthesis and Assessment Products” on various topics, which can be downloaded for free (www.globalchange.gov/engage/process-products/sap-summary).

Some useful websites:

Real Climate - www.realclimate.org – a blog on climate science that debunks the debunkers.

New York Times – www.nytimes.com – click on “Times Topics” and then “Global Warming”.

Science – www.sciencemag.org – good news and summaries of research articles up front.

Pew Center on Global Climate Change – www.pewclimate.org – good commentaries on climate policy.

International Energy Agency – www.iea.org – a good source for statistics on energy.

US Energy Information Administration – www.eia.doe.gov – lots of global energy statistics.

United Nations Framework Convention on Climate Change – www.unfccc.org – the international body under which the Kyoto Protocol was negotiated, and the sites lists reports from individual nations.

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned readings and activities and take all scheduled assignments and tests by due dates. You are expected to attend lectures where possible and participate in-class discussions and activities. You are also expected to take responsibility to follow up with recorded content, course notes, assignments, and course related announcements for lecture sessions that you have missed or lectures that are provided in an online-only format.

(2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

(3) ASE Diversity and Inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science. It is our goal to create an inclusive and collaborative learning environment that supports a diversity of thoughts, perspectives, and experiences, and that honours your identities (including ethnicity race, gender, socioeconomic status class, sexual orientation, religion or, ability., etc.).

To help accomplish this:

- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with one of the instructors or an ASE faculty member. We want to be a resource for you.
- Your classmates and instructors (like many people) are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to the instructors or an ASE faculty member about it.
- As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: (e.g., using preferred pronouns and names; being respectful of others opinions and actively, making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions., etc.).

We expect all members of the class to adhere to the NTU Anti-harassment policy (<https://ts.ntu.edu.sg/sites/policyportal/new/Documents/msrf%20included%20NIE%20staff/Anti-Harassment%20Policy.pdf>), if you witness something that goes against this or have any other concerns, please speak to your instructors or an ASE faculty member.

Academic Integrity

We take plagiarism, cheating, and other breaches of academic integrity very seriously, and these will likely result in a failing grade for the assignment or even the course. Please know the rules and consequences as defined in the NTU policy document on academic integrity (<http://www.ntu.edu.sg/ai/Pages/academic-integrity-policy.aspx>).

Some portions of the assessment and tutorials are designed to be done in groups, while others are intended to be done individually. Sometimes you can work and submit as a group. Other times, you may talk to your fellow students about your essay, but your submitted assignment must reflect only your own contributions and work. Make sure you understand the specific rules for group versus individual contributions for each assignment. If you are unsure, ask!

Course Instructors

Instructor	Office Location	Phone	Email
Asst Prof Joyce Ong	N2-01C-48		Joyce.ong@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	ILO	Tutorial Activities
1	Introduction to class and the climate change debate	1	Detailed information on assignments and rubrics, discussion on conversations about climate change
2	The global climate system	1, 2	Refresher on reference finding and basic structure of a scientific article
3	Climate systems in Southeast Asia	1, 2, 5	Summarising and assessing a scientific article
4	Climate models and uncertainties	1, 2	Exploring climate models
5	Climate impacts	2, 3, 4, 5	Discussion of climate impacts in Singapore and the region
6	Sea level change	2, 3, 4, 5	Critical assessment of the Singapore Green plan 2030
7	Mitigation and adaptation	2, 3, 4, 5	In-class MCQ quiz, followed by peer learning and discussion
8	International agreements and the politics of climate change	3, 4, 5	Discussion and preparation for Global Climate Change Simulation
9	Global Climate Change Simulation	3, 4, 5	Reflection on Global Climate Change Simulation, watch and grade group video assignments
10	Discussion on new IPCC AR6 report	3, 4, 5	Reflections on IPCC AR6, watch and grade group video assignments
11	Singapore perspectives on climate change	2, 3, 4, 5	Peer grading of the first draft of research papers
12	Society and climate change 1	1, 2, 3, 4, 5	Discussions on how humans have dealt with climate change in the past
13	Society and climate change 2	1, 2, 3, 4, 5	Discussions and reflections on the overall course, feedback.

Appendix 1: ASE Learning Outcomes

At the completion of your course of study in ASE, you will be able to:

- 1) Demonstrate intellectual flexibility and critical thinking in order to apply environmental knowledge in the real world
- 2) Communicate environmental concepts with enthusiasm to varied audiences both orally and in writing
- 3) Formulate scientific questions, and be able to access and analyse quantitative and qualitative information to address them
- 4) Exhibit the motivation, curiosity and skills for lifelong learning
- 5) Demonstrate ethical values and responsibility
- 6) Collaborate and lead by influence

Appendix 2: Assessment criteria for tutorial participation

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent)	<ul style="list-style-type: none"> - Student has thoroughly read the given materials as well as several additional materials for context. - Student has rigorously considered their own opinion in relation to key concepts and theories from the reading material. - Participates in class discussions in a considered and respectful fashion. - Is prepared to contribute to the discussion at an appropriate time - Discussion points are insightful, relevant and thought provoking. - Questions or counter points are thoughtful, logical and unexpected, sometimes presenting a new viewpoint to the discussion.
A- (Very good)	<ul style="list-style-type: none"> - Student has read the given materials. - Participates in class discussions in a considered and respectful fashion. - Is prepared to contribute to the discussion at an appropriate time. - Discussion points are insightful and relevant. - Questions or counter points are thoughtful and logical.
B+ (Good) B (Average)	<ul style="list-style-type: none"> - Student has read most of the given materials. - Participates in class discussions in a considered and respectful fashion - Is somewhat prepared to contribute to the discussion at an appropriate time. - Discussion points are mostly relevant. - Questions or counter points are logical.
B- (Satisfactory) C+ (Marginally satisfactory) C (Bordering unsatisfactory)	<ul style="list-style-type: none"> - Student has read some of the given materials. - Participates in class discussions in an unconsidered or disrespectful fashion. - Discussion points are irrelevant.
C- (Unsatisfactory) D (Deeply unsatisfactory)	<ul style="list-style-type: none"> - Student has read few of the given materials. - No participation in the majority of tutorials. - Is not prepared to contribute to the discussion at any time.
F (0-44)	<ul style="list-style-type: none"> - Failure to do the readings. - Failure to participate in any way.

Appendix 3: Assessment criteria for video presentation

Grade / Numerical Score	Criteria
<p>A+ (Exceptional) A (Excellent) A- (Very good)</p>	<ul style="list-style-type: none"> - Video is laser focused on the topic and information provided is very easy to understand. - Video demonstrates an obvious depth of knowledge on the topic. - Excellent, well thought out explanation shows superior effort. - More than one case study or primary document appropriately used with a lot of evidence-based research. - Well-organized with a continuous progression of ideas within a complete story. - Intro and outro add to the high level attained by the video. - Credits/citations are given to appropriate sources. - Excellent sense of design and effective camera techniques used for video and pictures, which are in focus, of good quality and have smooth transitions. - Audio/video effects flow exceeding well and are of high quality.
<p>B+ (Good) B (Average) B- (Satisfactory)</p>	<ul style="list-style-type: none"> - Video focused on an informative topic and information provided is fairly accessible and easy to understand. - Video demonstrates a depth of knowledge on the topic, good explanation of terms and concepts. - Project is well researched and shows good effort. - Only one case study or primary document semi-appropriately used. - Fairly well-organized and documented, format easy to follow. - Video has an intro and an outro that is consistent with the rest of the video. - Credits/citations are given to appropriate sources. - Good use of graphics and/or other design elements. Some transitions inappropriately placed. Video clips or pictures clear and in focus. - Images or camera angles change every 7-15 seconds or so. Audio/video effects are of acceptable quality with a few distracting aspects.

<p>C+ (Marginally satisfactory)</p> <p>C (Bordering unsatisfactory)</p>	<ul style="list-style-type: none"> - Project has problems staying focused on topic and information provided is incoherent at times. - Video demonstrates a shallow depth of knowledge on the topic, there is some explanation of terms and concepts. - Project is researched to a fair degree and shows some effort. - Only one case study or primary document used and it was questionably used or cited. - Portions poorly organized and documented, hard to follow progression. - Video has an intro and an outro that is of moderate quality. - Credits/citations may or may not be present. - Minimal use of graphics and/or other design elements. No transitions, video clips or pictures out of focus or “shaky”. - Some screens do not change angles/colors/words very frequently. Audio/video effects are of moderate quality with a few distracting aspects such as background noises.
<p>C- (Unsatisfactory)</p> <p>D (Deeply unsatisfactory)</p>	<ul style="list-style-type: none"> - Project does not stay focused on topic, usefulness is in question and does not inform. - No case study or primary document used. - Low quality of video, poor effort. - Poorly organized, difficult to follow. - Video has an intro and/or outro that is of low quality. - No credits/citations used at all. - Use of design elements detracts from video. Too many or too gaudy graphics, too many clips. Video clips or pictures out of focus or “shaky”. - One image on screen for an elongated period of time. Audio/video is garbled and hard to decipher. Too much background interference.
<p>F (0)</p>	<ul style="list-style-type: none"> - Fail to submit video.

Appendix 4: Assessment criteria for research paper

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent) A- (Very good)	<ul style="list-style-type: none">- Clearly presents a central idea, which is supported throughout the paper.- Content exceptionally well-presented and argued; ideas are detailed, well-developed, supported with specific evidence and facts.- Research sources are exceptionally well-integrated and they support claims argued in the paper very effectively. Multiple sources/references that conform to Harvard referencing style.- Figures are exceptionally well-integrated and they support claims argued in the paper very effectively. Figures have an excellent standalone caption and appropriate referencing.- Purpose of paper is clear, overall organization well-planned and well-thought out. Includes title, introduction, statement of main idea, transitions and conclusion.- All paragraphs have clear ideas, are supported with examples and have smooth transitions. Sentences are clear and varied in pattern, from simple to complex, with excellent use of punctuation.- There is clear use of a personal and unique style of writing, suited to audience and purpose; concise writing that holds the reader's interest with ease.- Relevant and specific examples and detailed descriptions.- Excellent grammar, spelling, syntax and punctuation.

<p>B+ (Good) B (Average) B- (Satisfactory)</p>	<ul style="list-style-type: none"> - Central idea supported throughout most of the paper. - Content well-presented and argued; ideas are detailed, developed, supported with mostly specific evidence and facts. - Research sources are well-integrated and they support claims argued in the paper. Multiple sources/references that conform to Harvard referencing style. - Figures are integrated and they support claims argued in the paper effectively. Figures have a good standalone caption and appropriate referencing. - Paper shows awareness of purpose, good overall organization. Includes main organizational tools. - Most paragraphs have clear ideas, are supported with some examples and have transitions. Sentences are clear but may lack variation, some awkward sentences with a few punctuation errors. - There is an attempt at a personal style but style of writing may be awkward or unsuited to audience and purpose; the reader may lose interest in some sections of the paper. - Some use of specific examples and detailed descriptions. May have extended examples that go on for too long. - A few errors in grammar, spelling, syntax and punctuation, but not many.
<p>C+ (Marginally satisfactory) C (Bordering unsatisfactory)</p>	<ul style="list-style-type: none"> - Vague sense of a central idea, weakly supported throughout the paper. - Content sound; ideas present but not particularly developed or supported, some evidence but usually of a generalized nature. - Sources support some claims made in the paper but might not be integrated well within the argument. Some errors with regard to Harvard referencing style. - Figures have limited impact on the essay or provide minimal support for claims argued. Captions may not be well thought out or no appropriate referencing. - Paper shows limited awareness of purpose. There is a sense of organization, although some of the organizational tools are used weakly or missing. - Some paragraphs have clear ideas, support from examples may be missing and transitions are weak. Sentences generally clear but may have awkward sentences or unclear content; there may be patterns of punctuation errors. - Little attempt at style, reads as flat and uninteresting in content; which is usually generalized and cliched. - Little use of specific examples and descriptions, mostly generalized examples and little descriptions. - Pattern of errors in grammar, spelling, syntax and punctuation. Could also be a sign of lack of proof-reading.

<p>C- (Unsatisfactory) D (Deeply unsatisfactory)</p>	<ul style="list-style-type: none"> - No central idea. - Content not sound. - Research sources are not well-integrated or does not use adequate research. Sources/references do not conform to Harvard referencing style. - Figures are inappropriate, useless or do not exist. - No awareness of purpose, no sense of organization. - Paragraphs lack clear ideas. Sentences are unclear. - No attempt at style. - No use of examples. - Continuous errors in grammar, spelling, syntax and punctuation.
<p>F (0)</p>	<ul style="list-style-type: none"> - Fail to submit research paper.

Appendix 5: Assessment criteria for peer feedback

Grade / Numerical Score	Criteria
A+ (Exceptional) A (Excellent)	<ul style="list-style-type: none"> - Comments are comprehensive, detailed and clear. - Feedback thoroughly considers content, structure, language, interpretation of information and resources used. - All points for improvement are constructive, feasible and reasonable. - All points for improvement are specific and achievable.
A- (Very good)	<ul style="list-style-type: none"> - Comments are mostly comprehensive, detailed and clear. - Feedback mostly considers content, structure, language and resources. - Most points for improvement are constructive, feasible and reasonable. - All points for improvement are specific and achievable.
B+ (Good) B (Average)	<ul style="list-style-type: none"> - Comments are somewhat comprehensive, detailed and clear. - Feedback somewhat considers content and structure. - Some points for improvement are constructive, feasible and reasonable. - Most points for improvement are specific and achievable.
B- (Satisfactory) C+ (Marginally satisfactory) C (Bordering unsatisfactory)	<ul style="list-style-type: none"> - Comments are sparse and unclear. - Feedback does not consider content, structure, language, interpretation of information or resources used. - Points for improvement are largely unconstructive. - Points for improvement are largely vague and unachievable.
C- (Unsatisfactory) D (Deeply unsatisfactory)	<ul style="list-style-type: none"> - No reference to specific parts of the talk is made. - Feedback does not consider content, structure, timing or delivery. - No points for improvement are constructive. - No points for improvement are specific or achievable.
F (0-44)	<ul style="list-style-type: none"> - No comments given. - Failure to give feedback.