Course Title	:	Space and Time
Course Code	:	CLD9023
Recommended Study Year	:	Any
No. of Credits/Term	:	3
Mode of Tuition	:	Lecture and tutorial
Class Contact Hours	:	2 hours Lecture/week; 1 hour Tutorial/per week
Category	:	CLD - Science, Technology and Society Cluster
Discipline	:	-
Prerequisite(s)	:	-
Co-requisite(s)	:	-
Exclusion(s)	:	-
Exemption Requirement(s)	:	-

Brief Course Description

Is there such a thing as space? Are there absolute positions in space, so that one may return to the exact same location in space at different times? Can one be absolutely stationary, or is all motion relative? What does it mean to say that space is curved? Do we live, as Einstein supposed, in a four dimensional static block universe that contains both the past and the future? Or does only the present exist? Could we build a time machine and travel back in time? This course will address these and other questions by looking at the theories of space and time proposed by arguably the three greatest scientists in history – Aristotle, Newton and Einstein – and by looking at the conceptual and philosophical implications of these theories. No background knowledge of physics will be presupposed in this course.

Aims

The aim of this course is to

1. provide students with a good basic understanding of Aristotle's physics, Newton's physics and Einstein's theory of relativity,
2. provide students with a good basic understanding of a number of conceptual and philosophical issues regarding space and time and their relation to different scientific theories of space and time,
3. enhance the abilities of students to understand and evaluate views and arguments in the conceptual foundations of the physics of space and time, and
4. enhance the abilities of students to solve problems, articulate solutions to problems, and to detect, construct and evaluate arguments.

Learning Outcomes

Students who complete this course are expected to be able to

1. describe the basic features of Aristotle's physics, Newton's physics and Einstein's theory of relativity, and answer questions testing the knowledge of these theories
2. articulate a number of conceptual and philosophical questions regarding these theories, and describe and critically evaluate different competing answers that have been proposed to these questions,
3. articulate their own views about what the correct answers to these questions are, and defend these views by developing arguments defending them.

Indicative Content

1. Conceptions of the universe in the ancient world
2. Aristolean physics and Ptolemaic astronomy
3. Newtonian physics
4. The nature of space in Newtonian physics

5. The paradox of time
6. Special relativity
7. Relativity and measurement
8. General relativity
9. Is time travel possible?
10. Presentism and eternalism

Teaching Method
Lectures and tutorials

Measurement of Learning Outcomes
1. Answering tutorial questions: corresponding to LO1-3
   Tutorials will consist of students asking questions about material in the lectures and readings and answering questions given out in the tutorials.
2. Class participation: corresponding to LO1-3
   Students will be assessed on the degree of participation they make to discussion in class.
3. Midterm exam and final exam: corresponding to LO1-3
   These two exams will consist in short answer questions that test the student's knowledge of the course material and their ability answer questions, solve problems and construct short arguments relating to this material.
4. Essay writing: corresponding to LO1-3
   Each student will write one essay of length 1200 words. This essay will test students ability to display their knowledge of course material and construct their own arguments in an essay format.

Evaluation of the essay and answers to questions in the midterm exam and final exam will be based on either the attached Essay Grading Rubric (see attachment), or on a replacement rubric chosen by the instructor (and approved by the department board).

Assessment
1. Class participation in lectures and tutorials (15%)
2. Midterm exam (20%)
3. Essay (25%)
4. Final Exam (40%)

Required Readings
Lewis, David: The Paradoxes of Time Travel, *American Philosophical Quarterly*, 13 (2):145-152, 1976.
Maudlin, Tim: *Philosophy of Physics: Space and Time*, Princeton: Princeton University Press, 2012.
Sider, Theodore: Time, in Conee, Earl & Sider, Theodore (eds.), *Riddles of Existence: A Guided Tour of Metaphysics (second edition)*, Oxford: Oxford University Press, 2014.
Sider, Theodore: Temporal Parts, in Theodore Sider, John Hawthorne & Dean W. Zimmerman (eds.), *Contemporary Debates in Metaphysics*, Chicester: Blackwell, pp. 241-262, 2007.

Supplementary Readings
Dainton, Barry: *Time and Space*, Montreal and Kingston: Mcgill-Queen's University Press, 2001.
Geroch, Robert: *General Relativity from A to B*, Chicago: University of Chicago Press, 1981.
Kuhn, Thomas S.: *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought*, Cambridge: Harvard University Press, 1957.
Sider, Theodore: *Four Dimensionalism: An Ontology of Persistence and Time*, Oxford: Oxford University Press, 2001.

Sklar, Lawrence: *Space, Time and Spacetime*, Berkerley: University of California Press, 1974.