

STS-UY.2274 Space and Spacetime

Department of Technology, Culture and Society, NYU-Tandon

Prof: Jonathan Bain
jon.bain@nyu.edu
research.engineering.nyu.edu/~jbain/spacetime

Off. Hr: Tues 12:30-1:30pm (Zoom)
Office: 2MTC, 9th Fl., Rm929

Fall 2022 RH304
M/W 12-1:50pm

I. Instructional Format: Instruction will be conducted in-class (unless circumstances require otherwise). Please be aware of the NYU policy on face masks at <https://www.nyu.edu/life/safety-health-wellness/coronavirus-information/safety-and-health/protective-equipment.html>. Everyone in this class must wear an allowed type of face mask that properly covers your nose and mouth at all times. Eating in the classroom is strictly prohibited, and if you need to drink something during the lecture, please do so outside the classroom. You may do so at any time without asking for permission. Allowable masks are:

- Disposable masks (surgical or medical procedure masks).
- KN95, KF94, N95 masks.

Masks that are not acceptable are:

- Masks with one-way valves or vents.
- Bandanas, scarves, and face covering made with other repurposed clothing items.
- Cloth masks, unless being used as a second layer over a disposable mask.

II. Description: What is the nature of space? Is it an independently existing substance or does it consist in the relations between physical objects? Can motion be described in terms of the relational properties of objects, or must we always define motion with respect to an absolute motionless substratum? Does the existence of left-handed gloves entail the existence of absolute space? In this course, we will consider these and other questions about the nature of space and time as they appear in the writings of philosophers ranging from Plato and Aristotle, through Descartes and Newton, and culminating in Einstein and 20th-century conceptions of space and time.

III. Objectives

HuSS (Humanities and Social Sciences) General Education Objectives

Think critically, creatively and independently; demonstrate information literacy; demonstrate skills in inquiry and analysis; demonstrate effective oral communication skills; demonstrate effective writing skills; bring the perspectives of HuSS to bear on technical discourse; demonstrate ethical reasoning.

STS (Science, Technology and Society) Cluster Objectives

- Demonstrate a basic understanding of the following:
 - How sci & tech shape society (in historical, philosophical, sociological, cultural, and technical ways).
 - How social processes frame sci and tech enterprises, including theory construction, invention, and innovation.
 - The relation between the content of sci/tech knowledge, and the social context in which it is created.
- Demonstrate technical proficiency in a field in the natural sciences or engineering.
- Demonstrate ability to critically analyze and communicate issues involving interactions among sci, tech, & society.

IV. Required Readings:

A. At Bookstore or on reserve at Dibner:

1. [H] Huggett, N. (ed.) (1999), *Space from Zeno to Einstein*, Cambridge: MIT Press.

B. Online at course website:

2. [N] Norton, J. (2019), 'The Hole Argument', *The Stanford Encyclopedia of Philosophy*, E. Zalta (ed.). plato.stanford.edu/entries/spacetime-holearg.
3. [R] Rynasiewicz, R. (2011), 'Newton's Views on Space, Time, and Motion', *The Stanford Encyclopedia of Philosophy*, E. Zalta (ed.). plato.stanford.edu/entries/newton-stm.
4. [S] Slowik, E. (2021) 'Descartes' Physics', *The Stanford Encyclopedia of Philosophy*, E. Zalta (ed.), plato.stanford.edu/entries/descartes-physics.

V. Requirements

1. **Two papers** of 5-7 pages. Suggested topics will be provided at least 2 weeks before their due dates.
 - (a) Papers must conform to writing guidelines that will be handed out in class.
 - (b) Papers should be submitted online to the relevant link in the Assignments folder in Brightspace.
 - (c) *Late paper policy*: There are no extensions on paper due dates. Late papers will be accepted but will be given an initial penalty of a third of a grade point, and a further penalty of a third of a grade point for every period of 7 days after the due date. *Example*: An A paper turned in 1-7 days late will receive an A-; an A paper turned in 8-14 days late will receive a B+; an A paper turned in 15-21 days late will receive a B; etc. *Under no circumstances will late papers be accepted after the due date of the final.*
2. **Eight homework assignments**. These will be posted to the Assignments folder in Brightspace. These will consist of 3 questions from the study guide questions. Please submit them by their due dates to links that will be activated in the Assignments folder in Brightspace. One or two optional extra credit homework assignments will also be given over the course of the semester.
3. One **midterm** and one **final**. Each exam will consist of 8 short answer questions, of which you will be asked to pick 6 to respond to; and 3 short essay questions, of which you will be asked to pick 2 to respond to. A response to a short answer question should be no more than 1 paragraph in length (~3-4 sentences), and a response to a short essay question should be no more than 1 page in length (~3-4 paragraphs). Both the midterm and the final will be open-book, open-notes, take-home exams and should be submitted to the relevant link in the Assignments folder in Brightspace.

VI. Grade Distribution

Homework: 20% Midterm: 20% Papers: 2@20% = 40% total Final: 20%

VII. Reminders on University Policies

1. **Inclusion Statement**. NYU values an inclusive and equitable environment for all students. I hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect. It is my intent that all learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. If this standard is not being upheld, please feel free to speak with me.
2. **Moses Statement**. If you are student with a disability who is requesting accommodations, please contact the Moses Center for Students with Disabilities (CSD) at 212-998-4980, mosecsd@nyu.edu, nyu.edu/csd, 726 Broadway, 2nd Flr. You must be registered with CSD to receive accommodations.
3. **Standards and Procedures**. The NYU-Tandon Office of Student Affairs maintains a Community Standards and Procedures website at engineering.nyu.edu/life/student-affairs/community-standards-procedures. It contains information relevant to:
 - (i) **Incompletes**. It is NYU-Tandon policy that incompletes can be given only in extenuating circumstances (medical emergencies, accidents, etc.). An incomplete cannot be given because of a heavy course load, job commitments, or because you've simply fallen behind. For this reason, you should attend every lecture and make sure you're aware of assignment deadlines and exam dates. If you find yourself falling behind during the semester, do not hesitate to contact me. If you think you qualify for an incomplete grade at the end of the semester, see the procedure in (ii) below.
 - (ii) **Excuses due to illness or circumstances**. If you are experiencing an illness or any other situation that might affect your academic performance in a class (for instance, if you have to miss a lecture or an exam), please email Deanna Rayment, Coordinator of Student Advocacy, Compliance and Student Affairs, Dibner Hall Room LC 240C, eng.studentadvocate@nyu.edu. Deanna can reach out to your instructors on your behalf when warranted.
 - (iii) **University Honor System**. Please be aware of the university policy on cheating and plagiarism in the Student Code of Conduct. Cheating on an exam, or plagiarizing on an essay assignment, are sufficient reasons for receiving an F in the course. The Code of Conduct can be downloaded from the Office of Student Affairs website listed above.
4. **University Policy on Grading**. The following is NYU-Tandon's grading policy for all undergrad classes:

A	Excellent (4.0)	C+	Passing (2.3)	F	Failing (0.0)	AUD	Audit
A-	Excellent (3.7)	C	Passing (2.0)	S	Satisfactory	NR	Not Received
B+	Good (3.3)	C-	Deficient, but passing (1.7)	U	Unsatisfactory	P	Passing
B	Good (3.0)	D+	Deficient, but passing (1.3)	W	Withdrawal	MR	Must Repeat
B-	Good (2.7)	D	Deficient, but passing (1.0)	I	Incomplete		

VIII. Class Schedule

Reading assignments should be completed by the date on which they appear. This schedule may need to be modified over the course of the semester.

1		Weds 9/7. <i>Introduction</i>
2	Mon 9/12. <i>Plato</i> Reading: [H] Chap 1.	9/14. <i>Euclid</i> Reading: [H] Chap 2.
3	9/19. <i>Euclid, cont.</i> Homework #1 due.	9/21. <i>Zeno</i> Reading: [H] Chap 3.
4	9/26. <i>Zeno, cont.</i>	9/28. <i>Aristotle</i> Reading: [H] Chap 4.
5	10/3. <i>Aristotle, cont.</i> Homework #2 due.	10/5. <i>The Aristotelian Tradition</i> Reading: [H] Chap 5.
6	Tues 10/11. <i>Descartes</i> Reading: [H] Chap 6.	10/12. <i>Descartes, cont.</i> Reading: [S]. Paper 1 due.
7	10/17. <i>Newton</i> Reading: [H] Chap 7. Homework #3 due.	10/19. <i>Newton, cont.</i> Midterm handed out.
8	10/24. <i>Leibniz and Clark</i> Reading: [H] Chap 8.	10/26. <i>Berkeley and Mach</i> Reading: [H] Chap 9. Midterm due.
9	10/31. <i>Berkely and Mach, cont.</i> Homework #4 due.	11/2. <i>Spacetime</i> Reading: [H] Chap 10.
10	11/7. <i>Spacetime, cont.</i>	11/9. <i>Kant and Handedness</i> Reading: [H] Chap 11.
11	11/14. <i>Kant and Handedness, cont.</i> Homework #5 due.	11/16. <i>Kant and Geometry</i> Reading: [H] Chap 12.
12	11/21. <i>Poincaré</i> Reading: [H] Chap 13.	11/23. No Class (Thanksgiving Break)
13	11/28. <i>Einstein & Special Relativity</i> Reading: [H] Chap 14. Homework #6 due.	11/30. <i>Special Relativity, cont.</i> Paper 2 due.
14	12/5. <i>General Relativity</i>	12/7. <i>The Hole Argument</i> Reading: [N].
15	12/12. <i>Spacetime and Quantum Gravity</i> Homework #7 due.	12/14. <i>Makeup and review</i> Homework #8 due; Final handed out.
16	Weds 12/21. Final due.	