

NS 547 Concepts in Modern Physics II: Special Relativity and Related Topics Course Schedule

N.B.: The schedule below has not yet been adapted to the blended schedule of online and in-class meetings. Course readings may vary between course offerings.

Session 1: Units of Measurement for Spacetime Physics.

Spacetime Physics: Chapter 1.

Assignment: Selected problems - Chapter 1.

Reading Assignment for Session 2:

- *Making of the Atomic Bomb:* Chapter 2

Session 2: Inertial Frames and Measuring Time.

Spacetime Physics: Chapter 2.

Assignment: Selected problems - Chapter 2.

Reading Assignment for Session 3:

- *Making of the Atomic Bomb:* Chapter 3

Session 3: The Principle of Relativity

Spacetime Physics: Chapter 3.

Assignment: Selected problems - Chapter 3.

Reading assignment for session 5:

- Scherr, R., Schaffer, P. & Vokos, S. (2002). The challenge of changing deeply held student beliefs about the relativity of simultaneity. *American Journal of Physics*, 70 (2), 1238-1248.
- Scherr, R., Schaffer, P. & Vokos, S. (2001). Student understanding of time in special relativity: Simultaneity and reference frames. *American Journal of Physics*, 69 (S1), S24-S35.
- *Making of the Atomic Bomb:* Chapter 4

Session 4: The Lorentz Transformation.

Spacetime Physics: Special Topic: Lorentz Transformation.

Assignment: Selected problems on Lorentz transformation.

Reading Assignment for Session 5:

- *Making of the Atomic Bomb:* Chapter 6

Session 5: Lorentz transformations, Simultaneity, Twin Paradox.

Spacetime Physics: Chapter 4.

Mathematics and Problem-Solving: The mathematics of transformations.

Assignment: Selected problems - Chapter 4.

Philosophy/History/Education Research: Misconceptions on simultaneity and reference frames

Reading Assignment for Session 6:

- *Making of the Atomic Bomb:* Chapter 8

Session 6: The Worldline and a Spacetime Map

Spacetime Physics: Chapter 5.

Assignment: Selected problems - Chapter 5.

Reading Assignment for Session 7:

- *Making of the Atomic Bomb*: Chapter 10

Session 7: Regions of Spacetime

Spacetime Physics: Chapter 6.

Assignment: Selected problems - Chapter 6.

Reading Assignment for Session 8:

- *Making of the Atomic Bomb*: Chapter 11

Session 8: Momentum and Energy: Four Vectors and Momenergy

Midterm test

Spacetime Physics: Chapter 7.

Assignment: Selected problems - Chapter 7.

Philosophy/History/Education Research: Students' presentations

Reading Assignment for Session 9:

- *Making of the Atomic Bomb*: Chapter 13

Session 9: Equivalence of Mass and Energy.

Spacetime Physics: Chapter 8.

Concepts: $E=mc^2$, fission, fusion, annihilation.

Assignment: Selected problems - Chapter 8.

Philosophy/History/Education Research: Students' presentations

Reading Assignment for Session 10:

- *Making of the Atomic Bomb*: Chapter 15 (p. 486-496)

Session 10: Applications of Energy and Mass Equivalence.

Assignment: More selected problems - Chapter 8.

Philosophy/History/Education Research: Students' presentations

Session 11: Gravity: Curved Spacetime in Action

Spacetime Physics: Chapter 9.

Assignment: Selected problems - Chapter 9.

Philosophy/History/Education Research: Students' presentations

Session 12: Cosmology.

Philosophy/History/Education Research: Students' presentations

Take home exam

Session 13: Wrap up

Philosophy/History/Education Research: Students' presentations

Course evaluation

Bibliography

Rhodes, R. (1986). *The Making of the Atomic Bomb*. Simon & Schuster, New York.

Selections from Physics Education Research Literature

Scherr, R., Schaffer, P & Vokos, S. (2002). The challenge of changing deeply held student beliefs about the relativity of simultaneity. *American Journal of Physics*, 70 (2), 1238-1248.

Scherr, R., Schaffer, P & Vokos, S. (2001). Student understanding of time in special relativity: Simultaneity and reference frames. *American Journal of Physics*, 69 (S1), S24-S35.