PHY 151 – Introduction to Special Relativity. 1.0 credit hours **D-Term 2015**

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Course Description We will explore the surprising consequences of Einstein's postulate that the speed of light is the same for all observers, regardless of their motion relative to the light source. Class sessions will be conducted in a seminar format, and will be focused on student-led problem solving rather than instructor's lectures. Through reading, discussion, and problem solving we will learn how observers in different *reference frames* may disagree about measurements of length and time intervals between two *events*, and we'll learn how to use *spacetime diagrams* to represent each observer's measurements. We'll learn why objects cannot move faster than the speed of light. The course concludes with a study of relativistic energy and momentum with applications to nuclear and high-energy physics. If possible, we will tour the Fermi National Accelerator Laboratory in Batavia, where protons are accelerated to nearly the speed of light and collisions of high-energy particles transform energy into mass and vice versa.

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

- State the principle of relativity.
- Represent events using a spacetime diagram.
- Use Lorentz transformations to transform spacetime coordinates between reference frames.
- Use a spacetime diagram to transform spacetime coordinates from one reference frame to another.
- Explain why no object can move faster than the speed of light.
- Apply the concept of conservation of four-momentum to particle decays or collisions.

Textbooks

- Moore, *Six Ideas that Shaped Physics, Unit R: The Laws of Physics Are Frame-Independent*, 3rd ed., McGraw Hill, 2015.
- Knight, *Physics for Scientists and Engineers*, 3rd ed.; Pearson. (Your PHY 141 textbook.)

Grading: Achievement: 70%, Effort: 30%

Achievement: Semi-weekly homework assignments will cover the basic concepts as well as applications of these concepts. You are strongly encouraged to work in small groups on homework.

Effort: Two equally weighted components based on preparation and in-class participation.

- **Preparation.** Students will be expected to complete the assigned reading and up to four homework problems before each class session, and must come to class prepared to present their problem solutions to the entire class.
- **Participation.** Students are expected to participate *actively* in class discussions and in-class problem solving, as well as one or two lab exercises and a field trip to Fermilab. Your score will be determined by the instructors' subjective assessment of your participation.

Score	0.00-59.99	60.00-68.99	69.00-69.99	70.00-77.99	78.00-79.99	80.00-81.99	82.00-87.99	88.00-89.99	90.00-90.99	91.00-100
Grade	F	D	C–	C	C+	B–	B	B+	A–	A

Everyone is capable of earning an A in this course!