THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

DEPARTMENT OF PHYSICS

PHY 317 – Special Relativity

COURSE PARTICULARS

Course Code: PHY 317
Course Title: Special Relativity
No. of Units: 2
Course Duration: Two hours of theory per week for 15 weeks.
Status: Compulsory
Course Email Address: phy317@gmail.com
Course Webpage: http://www.phy.futa.edu.ng/courseschedule.php?coursecode=PHY%20317
Prerequisite: PHY 201.

COURSE INSTRUCTORS

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COURSE DESCRIPTION

This course is conceptual and exploratory, a course that describes the relative motion of different bodies in different frame of references. It compares different theories and establishes the most reliable one, identified through valid and consequential experimental investigations. The course is designed primarily for students in Physical Sciences. The focus is to reveal the limitations to Newtonian mechanics and the appropriate resolution so as to demonstrate the validity of physical laws and the constancy of the speed of light. The course will handle the calculations of differences in measured parameters from different frames of references at relative motion or at rest relative to each other.

COURSE OBJECTIVES

The objectives of this course are to:

- introduce students to the concept of special relativity and its applications to Physical Sciences; and
- provide students with knowledge and proof of the validity of Physical Laws and non-existence of the hypothetical stationary aether.

COURSE LEARNING OUTCOMES / COMPETENCIES

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- establish the non-existence of the hypothesised stationary aether through the null result of Michelson-Morley experiments with interferometer.
- explain the true nature of Newtonian mechanics and Lorentz Transformation equations.
- understand the concept of constant relative motion of different bodies in different frames of references

(Skills)

- use Michelson-Morley Interferometer Experiment to:
    - refute the existence of a referenced stationary aether;
    - proof the constancy of the speed of light;
- use the Lorentz Transformation equation to:
    - describe events and how it will be reported by different observers in different frames of references;
    - determine proper time and dilated time;
    - determine proper length and contracted length;
    - proof the invariability of physical laws;

GRADING SYSTEM FOR THE COURSE

This course will be graded as follows:

Class Attendance/Quiz	10%
Assignments	10%
Test(s)	20%
Final Examination	60%
TOTAL	**100%**

GENERAL INSTRUCTIONS

Attendance: It is expected that every student will be in class for lectures. Attendance records will be kept and used to determine each person's qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with the instructor, indicating the reason for the absence.

Academic Integrity: Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited. You are not allowed to make copies of another person's work and submit it as your own; that is plagiarism. All cases of academic dishonesty will be reported to the University Management for appropriate sanctions in

accordance with the guidelines for handling students' misconduct as spelt out in the Students' Handbook.

Assignments and Group Work: Students are expected to submit assignments as scheduled. Failure to submit an assignment, as at when due, will earn you zero for that assignment. Only under extenuating circumstances, for which a student has notified the instructor in advance, will late submission of assignments be permitted.

Code of Conduct in Lecture Rooms and Laboratories: Students should turn off their cell phones during lectures. Students are prohibited from engaging in other activities (such as texting, watching videos, *etc*.) during lectures. Food and drinks are not permitted during lecture.

READING LIST

[1,2] Hugh D. Young and Roger A. Freedman (1995). *University Physics. 9th Edition.* Addision-Wesley Publishing Company, 1484p

[1,2] David Halliday, Robert Resnick and Jearl Walker (2008). *Fundamentals_of_Physics. 9TH Edition.* Wiley Publisher 1333p.

[1,2] Hugh D. Young, (2012). *Sears & Zemansky's College Physics. 9th Edition.* Pearson Education, Inc., Addison-Wesley, 1301 Sansome Street, San Francisco, CA, 94111, USA. 1151p.

[2] Ulrich E. Schrölder (1990). *Special Relativity: World Scientific Lecture Notes on Physics Vol. 33.* World Scientific, Singapore, New Jersey, London, Hong Kong. 214p

Legend
1- Available in the University Library
2- Available in Departmental/School Libraries
3- Available on the Internet.
4- Available as Personal Collection
5- Available in local bookshops.

COURSE OUTLINE

Week	Topic	Remarks
1	Introduction to Special Relativity: • Postulate of Special Relativity • Frames of References, event and Transformations	During this first class, there will be an introduction of the course and basic introductory topics.
2 & 3	Galilean Transformations and Limitation to Newtonian Mechanics Constancy of Speed of Light, Michelson-Morley Experiment: • Measuring Aether • The Experiment • Mathematical Analysis of the Michelson-Morley Experiment	Galilean transformation will be discussed and Michelson-Morley Interferometer experiment will be treated with the consequence of the experimental result.
4 & 5	Lorentz-Einstein Transformations • Lorentz Transformation equation • Mathematics of the Lorentz Transformation equation • Deduction of Lorentz Transformation from the Constancy of Velocity of Light • Lorentz velocity Transformation	Lorentz transformation will be explored extensively to describe what transpired between frames of references and how events are reported by observers from one frame of reference to another.
6 & 7	Space-Time Diagram Event and World Proper Time and Time Dilation • Time Dilation • Twin or Clock Paradox Proper Length and Length Contraction • Length Contraction • Lorentz-Fitzgerald Contraction	Extensive discussion will be made on Space time diagram and the disparity in Time and length measurement between frames of references that are in motion relative to each other.
8	MID-SEMESTER TEST	MID-SEMESTER TEST
9 & 10	Simultaneity of events and relativistic Addition of Events • Simultaneity • Addition f Velocity (Events) • Relativistic Velocity Addition Theorem Relativistic Kinematics and Dynamics Doppler Effect	There will be a discussion on occurrence of the same events in different reference frames and how velocity adds up in frames of references. Also effect of motion on frequencies of waves will be discussed.

11 & 12	Equivalence of Mass and Energy • Rest Energy Four Vectors Space time and Energy Momentum • Relativistic Momentum • Newton's Second Law	There will be an extensive explanation of what happen when a mass at rest breaks into two particles and flies apart. Also, the concept of momentum and change in rest mass after the break-up will be explored.
13 & 14	Invariant Relativity and Electric and Magnetic Field Invariance of Maxwell Equation	There will be an extensive exploration of the relationship between electromagnetic field and Maxwell equation in different reference frames that are in relative motion.
15	REVISION	This is the week preceding the final examination. At this time, there will be final revision and questions from the students will be attended to.