COURSE OUTLINE

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	MAT_AM333	**SEMESTER OF STUDIES**	6th
COURSE TITLE	SPECIAL RELATIVITY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures and Tutorials	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Elective course
PREREQUISITE COURSES:	Recommended prerequisite knowledge: LINEAR ALGEBRA I, CLASSICAL MECHANICS
TEACHING AND ASSESSMENT LANGUAGE:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBPAGE (URL)	http://www.math.upatras.gr/~tasos/special_relativity.html https://eclass.upatras.gr/courses/MATH956/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning*

and Appendix B

- *Guidelines for writing Learning Outcomes*

Special Relativity is the theory introduced by Albert Einstein in 1905, to describe, in a covariant way, the natural world and the laws that govern it in all Inertial frames of reference (IFRs). The course aims to:

- Introduce the students into the basic mathematical and physical concepts of the theory.
- Teach the effects of the Lorentz transformations.

The expected learning outcomes of the course are that the students will be able to:

- appreciate the fundamental four-dimensional character of space-time,
- use Lorentz transformations to relate events recorded at an IFR and how these events are recorded to other IFRs.
- construct space-time diagrams,
- describe the fundamental 4-vectors and use them to solve problems in relativistic dynamics,
- specify the electromagnetic field in problems of relativistic electrodynamics.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others…*
Production of new research ideas	

- Autonomous work.
- Teamwork.
- Production of new research ideas.
- Promotion of free, creative and inductive thinking.

3. COURSE CONTENT

Part One: Limitations of Classical Mechanics. Inertial Frames of Reference and Galilean Transformations. Limit of light speed. Experimental verification. The Michelson - Morley experiment.

Part Two: Einstein's Special theory of Relativity, Lorentz Transformations. Length contraction, time dilation. The twin paradox. Minkowski spacetime. Light cone. Relativistic Kinematics: Transformation of speeds and accelerations. Relativistic Doppler effect. Relativistic Mechanics: Force in Special Relativity. Conservation laws of momentum and energy. Mass-energy equivalence and the exact meaning of the relation $E = mc^2$. Collisions, particle creation and decay.

Part Three: Relativistic Electrodynamics: Maxwell's Equations. Electromagnetic waves. Relativistic covariance of electromagnetism.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures (face to face)
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	✓ *eClass* platform of the University of Patras, ✓ thought experiments ("Gedankenexperiments") using the computer.
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT ASSESSEMNT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students*	**Assessment Language:** Greek **Assessment Language for Erasmus students:** English **Assessment methods:** Written final course exam including: ✓ comprehensive questions, ✓ exercises and problem solving. Minimum pass grade: 5 Maximum pass grade: 10

Activity	***Semester workload***
Lectures	26
Tutorials	26
Solving suggested exercises	30
Personal study by the student	65
Final examination	3
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***150***

5. RECOMMENDED LITERATURE

(*in Greek*)

- Τσουμπελής Δημήτρης. *Ειδική Θεωρία Σχετικότητας*. Εταιρεία Αξιοποίησης και Διαχείρισης Περιουσίας Πανεπιστημίου Πατρών, 2012.
- Rindler Wolfgang. *Εισαγωγή στην Ειδική Σχετικότητα*. Εκδόσεις Liberal Books, 2001.

(*in English*)

- Rindler Wolfgang. *Introduction to Special Relativity*. 2nd ed., Clarendon Press, 1991.
- French Anthony P. *Special Relativity*. W. W. Norton & Company, 1968.