COURSE OUTLINE (1)

GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**24**	**SEMESTER**	**2**
COURSE TITLE	VECTOR CALCULUS		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
	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*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=1204

(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*

The course deals with tools of Applied Mathematics necessary for students in Physics and in Applied Sciences. Specifically, it deals with the introduction of vectors and tensors (like Kronecker's delta and the Levi-Civita antisymmetric tensor), their use in writing down the fundamental laws of Physics and their use in expressing the parametric equations of geometry (equations of a straight line or of conical sections) that arise in many physics problems. The course also focuses on understanding the fundamental theorems of vector calculus (Green's and Stokes' theorems) and their application in problems in classical electrodynamics and in fluid mechanics. Upon completion of the course, the students will be able to:

- Write down vectors in Cartesian and curvilinear coordinates (like cylindrical and spherical coordinates), perform all related calculations (addition, subtraction, inner and outer products) as well as perform more complex calculations with the aid of the index notation of vectors
- Apply transformations (rotation, parity) to vectors in order to express the physical laws in equivalent systems of coordinates
- Calculate the directional derivative, the gradient and the Laplacian of a scalar multivariate function as well as the divergence and the curl of a vector function in Cartesian and curvilinear coordinates
- Calculate double and triple integrals of scalar functions as well as path and surface integrals of vector functions in Cartesian and curvilinear coordinates
- Apply the fundamental theorems of vector calculus to problems in physics
- Calculate second order tensors and apply them to problems in physics (for example in solid body rotation and in electrodynamics)

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology. Working independently. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

Vector analysis in Cartesian, cylindrical and spherical coordinates. Vector transformation under rotation. Vector products and vector identities. Motion in a plane. Calculus of scalar and vector multivariate functions: directional derivative, gradient (in Cartesian and curvilinear coordinates), the nabla operator, divergence, curl and Laplacian. Double and triple integrals and

applications. Change of variables and Jacobian. Path and surface integrals. Fundamental theorems of vector calculus for the gradient, the divergence and the curl and applications in physics.

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Moodle on-line learning platform for the dissemination of notes, problem sets as well as contacting the students
TEACHING METHODS *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*	

Activity	*Semester workload*
Lectures	39
Tutorials	13
Bibliography study	52
Non-guided study	43

visits, project, essay writing, artistic creativity, etc.	Exams	3

(4) TEACHING and LEARNING METHODS - EVALUATION

The student's study hours for each learning activity are given as well as the hours of nondirected study according to the principles of the ECTS		
	Course total	***150***

STUDENT PERFORMANCE EVALUATION *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.*	Written exam at the end of the course containing theory and problem solving

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

Suggested bibliography :

- Leondaris G. K, Vector Calculus, Theodoridis Press, 2015
- Vergados I. D and G. K. Leondaris, Vector Analysis, , Symeon Press, 1996
- Marsden J. and A. Tromba, Vector Calculus (in Greek), Crete University Press, 2010
- Kraniotis, G. B. and G. K. Leontaris, Vector Calculus, Exercises and Problems with synoptic theory, Theodoridis Press, 2013
- Tsitsas L., Applied Vector Calculus, Athanasopoulos Press, 2003
- Sourlas D., Vector Analysis, Symmetria Press, 2010