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**
	5	8
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 the calculus (differential and integral) of scalar, real functions of two or more variables, as well as the calculus of vector functions of one and of many variables (fields). Upon completion of the course, the students will be able to:

- calculate the limits, determine the continuity and plot scalar real functions of two variables
- calculate the partial derivatives, the directional derivative and the gradient of a scalar multivariate function as well as determine and characterize its stationary points
- manipulate curves and study their characteristics as well as apply the Frenet-Serret apparatus to solve problems in mechanics
- use curvilinear coordinates (cylindrical, spherical, etc) to express scalar and vector fields in Physics as well as transform from one set of coordinates to another
- manipulate surfaces and calculate the tangent plane to a surface as well as the

normal vector

- calculate the divergence and the curl of vector fields in Cartesian and curvilinear coordinates, as well as the Laplacian of scalar and vector fields
- describe the applications of double and triple integrals in physics and calculate these integrals in Cartesian and curvilinear coordinates
- describe the applications of path integrals and potential functions in physics and to calculate path integrals as well as scalar and vector potentials for irrotational and solenoidal fields respectively
- calculate surface integrals of scalar and vector functions
- apply the fundamental theorems of vector calculus (gradient, Gauss, Stokes, Green) to problems in physics

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	*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	*……*
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

Real multivariate scalar functions, limits, continuity, partial derivatives, differential, directional derivative, gradient, Taylor expansion and stationary points. Vector functions of one variable, curves and the Frenet-Serret apparatus. Surfaces, tangent plane and normal vector. Analysis of scalar and vector fields in Cartesian, cylindrical and spherical coordinates. Calculus of scalar and vector multivariate functions: the nabla operator, divergence, curl and Laplacian (in Cartesian and curvilinear coordinates). Double and triple integrals, change of variables. Path integrals and potential functions, surface integrals. Applications of integrals in Physics. Fundamental theorems of vector calculus for the gradient, the divergence and the curl and applications in Physics.

(4) TEACHING and LEARNING METHODS - EVALUATION

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*	Projection of slides as well as interactive applications using Wolfram Alpha during lectures and use of Moodle on-line learning platform for the dissemination of notes, problem sets, ebooks, videos and applications as well as contacting the students.	
TEACHING METHODS	***Activity***	***Semester workload***

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*	Lectures	39
	Tutorials	13
	Bibliography study	85
	Non-guided study	45
	Exams	5
	Course total	***200***
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.*	Problem sets (short-answer questions and problem solving) during the semester and two written exams (midterm and final exam) containing theory and problem solving.	

(5) ATTACHED BIBLIOGRAPHY

- Leondaris G. and N. Bakas: Vector Calculus in Physics, Kleidarithmos, 2022
- Marsden J. and A. Tromba, Vector Calculus (in Greek), Crete University Press, 2020
- Tsitsas L., Applied Vector Calculus, Athanasopoulos Press, 2003
- Sourlas D., Vector Analysis, Symmetria Press, 2010
- Briggs W., L. Cochran and B. Gillett: Analysis, Kritiki Press, 2021