■ CE85 - Operator Theory

GENERAL

SCHOOL	EXACT SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE85	**SEMESTER**	H
COURSE TITLE	OPERATOR THEORY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Lectures	4	6

COURSE TYPE	Scientific Field
PREREQUISITE COURSES	Functional Analysis Topology
LANGUAGE OF TEACHING AND EXAMINATIONS	Greek/English
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uowm.gr/

LEARNING OUTCOMES

Learning Outcomes
Upon successful completion of the course, the student will be able to: • understand the concept of bounded/unbounded operator on a normed space, as well as the notion of operator norm, • prove that an operator is bounded and compute or estimate its norm, • know various categories of operators in Hilbert spaces (self-adjoint, positive, projection, etc.) through examples but also through theoretical characterizations of an algebraic and geometric nature,

- distinguish between the different categories of operators, either in general or in specific spaces,
- know the relationships between (orthogonal) projections (orthogonality, order, commutativity, pointwise convergence of sequences) and be able to use these in solving problems,
- know the concept of finite rank operator and compact operator and the relationship between these categories as well as their various characterizations,
- understand the Spectral Theorem for compact normal operators in Hilbert spaces and the diagonalization of such operators, as well as the general form (polar representation) of compact operators in Hilbert spaces,
- apply the spectral theory of compact operators to problem solving.

General Competencies

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adapting to new situations.
- Working in an interdisciplinary environment.
- Independent work.
- Team work.
- Generation of new research ideas.
- Promotion of free, creative and inductive thinking.

CONTENT OF THE COURSE

Euclidean spaces, inner products in infinite-dimensional spaces. Completeness, Hilbert spaces, basic properties, Closed operators, Examples, the conjugate operator, classes of operators, projections. Operators of finite order, compact operators, integral operators, diagonalization of operators, the spectral theorem for compact normal operators, Applications.

TEACHING AND LEARNING METHODS - EVALUATION

TEACHING METHOD	In the classroom.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	e-Lectures. Use of e-class. Communication through face-to-face discussions and e-mails.
TEACHING ORGANIZATION	

Activity	Semester Workload
Lectures	40 hours

	Teaching of exercises: 20 hours Solving of selected exercises: 40 hours Individual Study: 50 hours Course Total (25 hours per ECTS): 150 hours
STUDENT EVALUATION	Written final examination (100%) which includes: -Theory, -Exercises.

RECOMMENDED BIBLIOGRAPHY

1. Karanasios S., Theory of Operators & Applications, Publications Tsotras, 2nd ed., 2017. (Greek)
2. Katavolos A., Introduction to Operator Theory, Publications Symmetry, 2008. (Greek)
3. Ifantis E.K., Theory of Operators, Publications Stamoulis, 2004. (Greek)
4. Gohberg I., Goldberg S., Basic Operator Theory, Birkhäuser, 2001.
5. Kehe Zhu, Operator theory in Function Spaces, American Mathematical Society, 2nd edition, 2007.
6. Y. Abramovic, C. Aliprantis, An Invitation to Operator Theory, American Mathematical Society, 2002.
7. R.G. Douglas, Banach Algebra Techniques in Operator Theory, Springer- Verlag, 1998.