Course Description of Operator Theory

What is Operator Theory

In mathematics, operator theory is the study of linear operators on function spaces, beginning with differential operators and integral operators. The operators may be presented abstractly by their characteristics, such as bounded linear operators or closed operators, and consideration may be given to nonlinear operators. The study, which depends heavily on the topology of function spaces, is a branch of functional analysis.

Course Description

In this course, we aim to study the spectral theory of normal operators and continuous functional calculus. We begin with the introduction of Hilbert space and study bounded operators on these spaces. More often we compare the results on operators with operators on finite-dimensional Hilbert spaces (or matrices). In this way, we study the spectrum and its properties, spectral theorem for compact normal operators which is a generalization of finite-dimensional operators. The further generalization is the spectral theorem for normal operators.

Course Contents

- Review of Hilbert space Theory, Bounded operators on Hilbert spaces, examples
- · Adjoint an operator, examples, Self-adjoint, normal, positive, unitary, isometries, partial isometries
- Orthogonal projections with examples, invariant subspaces, numerical range and characterization of operators
- Banach Algebras, inertibility, spectrum
- Gelfand-Mazur theorem, spectral radius formula, spectral mapping theorem.
- Subdivion of the spectrum of an operator, properties of the various spectra
- Computing spectrum with examples
- Existence of square root, polar-decomposition.
- Compact operators, properties
- Spectral theorem for compact self-adjoint operators, spectral theorem for compact normal operators, Schmidt-decomposition, Monotone convergence theorem for self-adjoint operators
- Spectral theorem for self-adjoint operators, continuous functional calculus, spectral theorem for self-adjoint operators(multiplication form)
- Spectral theorem for normal operators (both integral and multiplication form), continuous functional calculus for normal operators.

Text Books

- 1. Conway, John B. A course in functional analysis. Second edition. Graduate Texts in Mathematics, 96. Springer-Verlag, New York, 1990.
- 2. Conway, John B. A course in operator theory. Graduate Studies in Mathematics, 21. American Mathematical Society, 2000.
- 3. Gohberg, Israel; Goldberg, Seymour; Kaashoek, Marinus A. Basic classes of linear operators. Birkhäuser Verlag, Basel, 2003.





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