Program	Type of studies (cycle)	Third cycle
	Name of the program	SEE Doctoral Studies in Mathematical Science

Course

Course title	**Spectral graph theory**			
Course code	Semester	Course status	ECTS credits	Contact hours
PMAT 670		Optional	10	30
Teaching staff	Teacher	Prof. Dr. Almasa Odžak		
	Other staff			

Course goals

The main goal of the course is to introduce basic aspects and techniques in spectral graph theory. Graphs are common models which appear in different areas of pure or applied mathematics, physics, chemistry, and computer science. During the last few decades special attention is devoted to research on quantum graphs, since they are natural models for many phenomena appearing in different scientific areas. A quantum graph identifies edges of a combinatorial graph with closed intervals and in addition it has a differential (or pseudo-differential) operator acting on functions defined on the collection of intervals.
Quite useful tool for the investigation of graphs ant their properties are matrices attached to graphs such as adjacency matrices or Laplacian matrix, or spectra of graph. These are central objects in spectral graph theory. Important tool used to analyze spectrum of quantum graphs are trace formulas on graphs.

Course content/topics

- Laplacian of graphs
- Spectra of graphs
- Graph characterization using spectra
- Operations on graphs and the resulting spectra
- Quantum graphs
- Operations on quantum graphs
- Spectra of quantum graphs
- Trace formulas on graphs
- Weil's low for graphs

LITERATURE

[1] F. R. K. Chung: Spectral Graph Theory, American Mathematical Society, 1997.
[2] G. Berkolaiko, P. Kuchment: Introduction to Quantum Graphs, American Mathematical Society, 2013.
[3] A. E. Brouwer, W. H. Haemers: Spectra of graphs, Springer, 2011.
[4] D. M. Cvetković, M. Doob, H. Sachs: Spectra of graphs, Johann Ambrosius Barth, Heidelberg - Leipzig, 1995.
[5] J. M. Harrison, K. Kirsten: Zeta functions of quantum graphs, arXiv:0911.2509v3 (2010)
[6] Y.Ershova , A. V. Kiselev: Trace formulae for graph Laplacians with applications to recovering matching conditions, Methods of Functional Analysis and Topology 18, 343–359 (2012)

Grading

	Criterion	Points	Cut-off points
1.	Written assignment		
2.	Project		
3	Final exam		
	Total	100	55