Obuda University John von Neumann Faculty of Informatics			**Institute of Applied Mathematics**	
Name and code: *Riemann-Hilbert problems for orthogonal polynomials with applications I*			**Credits*:*** *2022/23 year I. semester*	
Subject lecturers: Prof. dr. habil Árpád Baricz				
Prerequisites (with code):	Calculus I, II, Asymptotic Analysis			
Weekly hours:	Lecture:	Seminar.:	Lab. hours:	Consultation:
Way of assessment:				
Course description:				
Goal: to provide a deeper understanding of the Riemann-Hilbert problems for orthogonal polynomials and applications in random matrix theory.				
Course description: This course gives a basic introduction into the basics of the Riemann-Hilbert problems for classical orthogonal polynomials as well as for orthogonal polynomials with respect to modified/generalized Jacobi weight. During the course it will be presented the nonlinear steepest descent method of Deift and Zhou. Moreover, it is our aim to show some applications of the Riemann-Hilbert problems in the theory of random matrices.				

Lecture schedule	
Education week	*Topic*
1.	Introduction to orthogonal polynomials
2.	Classical orthogonal polynomials: Hermite, Laguerre, Jacobi
3.	Riemann-Hilbert problems for orthogonal polynomials
4.	The approach of Fokas, Its and Kitaev
5.	Riemann-Hilbert problems for orthogonal polynomials with respect to modified Jacobi weight
6.	Riemann-Hilbert problems for orthogonal polynomials with respect to generalized Jacobi weight
7.	The nonlinear steepest descent method of Deift and Zhou
8.	Asymptotics of orthogonal polynomials with respect to modified Jacobi weight
9.	Asymptotics of orthogonal polynomials with respect to generalized Jacobi weight
10.	Asymptotics of orthogonal polynomials for a weight with a jump
11.	Distribution of eigenvalues of random matrices
12.	Universality theorems for modified Jacobi unitary ensembles
13.	Increasing subsequences of permutations and the Tracy-Widom distribution
14.	Painleve equations, nonlinear Painleve special functions

Midterm requirements

Education week	*Topic*

2022. 06. 09.

Finalgrade calculation methods

Achieved result	Grade
89%-100%	excellent (5)
76%-88<%	good (4)
63%-75<%	average (3)
51%-62<%	satisfactory (2)
0%-50<%	failed (1)

Type of exam

Project presentation & Written exam

Type of replacement

Project presentation

References

Mandatory:

- J. Baik, P. Deift, T. Suidan, Combinatorics and random matrix theory, Graduate Studies in Mathematics, American Mathematical Society, 2016.
- P. Deift, Orthogonal polynomials and random matrices: a Riemann-Hilbert approach, Courant Lecture Notes in Mathematics, American Mathematical Society, 1999.
- A.B.J. Kuijlaars, Riemann-Hilbert analysis for orthogonal polynomials. Orthogonal polynomials and special functions (Leuven, 2002), 167--210, Lecture Notes in Math., 1817, Springer, Berlin, 2003.
- A.B.J. Kuijlaars, K.T.R. McLaughlin, W. Van Assche, M. Vanlessen, The Riemann-Hilbert approach to strong asymptotics for orthogonal polynomials on [-1,1], *Advances in Mathematics* 188(2) (2004) 337-398.

Recommended:

- A.B.J. Kuijlaars, M. Vanlessen, Universality for eigenvalue correlations from the modified Jacobi unitary ensemble, *International Mathematics Research Notices* 2002(2002) 1575-1600.
- M. Vanlessen, Strong asymptotics of the recurrence coefficients of orthogonal polynomials associated to the generalized Jacobi weight, *Journal of Approximation Theory* 125(2) (2003) 198-237.