AGU Graduate School of Engineering and Science ……
Program

COURSE RECORD

Code	**ECE515**
Name	**STATISTICAL ANALYSIS OF SIGNALS AND NETWORKS**
Hour per week	3 (3+0)
Credit	3
ECTS	10
Level/Year	Graduate
Semester	Fall
Type	Elective
Location	-
Prerequisites	None
Special Conditions	No
Coordinator(s)	Assoc. Prof. Dr. Sergey Borisenok
Webpage	-
Content	Inter-disciplınary introduction to the basic methods of statistical mechanics and thermodynamics for the analysis of signals and networks; Experience of application of statistical mechanics approach to real life problems (engineering, natural sciences, social sciences). The course covers: I. Statistical analysis of signals: Basic concepts of statistical mechanics and statistical thermodynamics; single channel signals; multi-channel (vector) signals. II. Statistical analysis of networks: Statistical mechanics and thermodynamics of networks; phase transitions in networks; architecture (topology) of networks; control methods for network statistical analysis.
Objectives	The purpose of this course is: 1. to deepen the student understanding of the basic principles of statistical mechanics and thermodynamics analysis; 2. to develop the student skills for practical analysis of one- and multi-channel signals in different real-life applications; 3. to develop the student skills for practical analysis of networks in different real-life applications; 4. to improve the student computational skills for statistical mechanics analysis; 5. to improve the student skills for their independent studies of original scientific literature.
Learning Outcomes	LO1. Learn the basic principles of statistical mechanics and thermodynamics analysis; LO2. Learn the analysis of one- and multi-channel signals with the methods of statistical mechanics and thermodynamics; LO3. Learn the analysis of networks with the methods of statistical mechanics and thermodynamics; LO4. Learn the computer tools for statistical mechanics analysis; LO5. Learn the examples of statistical analysis to real life problems (engineering, natural sciences, and social sciences).
Requirements	Basic knowledge of calculus.
Reading List	• M. Potters, W. Bialek, “Statistical mechanics and visual signal processing”, Journal de Physique I, EDP Sciences, Vol. 4 (11), pp.1755-1775 (1994). • D. Wang, “Application of statistical physics in time series analysis”, Nanjing University (2007). • W. Kinzel, “Statistical physics of neural networks”, Computer Physics Communications, Vol. 121–122, pp. 86–93 (1999). • J. Park and M. E. J. Newman, “Statistical mechanics of networks”, Physical Review E, Vol. 70, p. 066117 (2004). • Ch. H. Yeung, D. Saad, “Networking - A Statistical Physics Perspective”, Journal of Physics A: Mathematical and Theoretical, Vol. 46, p. 103001 (2013).

	• R. Albert, A.-L. Barabasi, "Statistical mechanics of complex networks", Reviews of Modern Physics, Vol. 74, p. 47 (2002).
Ethical Rules and Course Policy	Cooperation vs. Cheating • Grading will be based on individual performance. Students are expected to be aware of the difference between cooperation and cheating (if you cannot distinguish the difference, please ask for advice). Plagiarism • Definition: the practice of taking someone else's work or ideas and passing them off as one's own. • Proper citing is suggested to avoid plagiarism. Latecomers • You are allowed to join the class maximum 10 minutes after the class starts.

LEARNING ACTIVITIES

Activities	**Number**	**Weight (%)**
Lecture	14	10%
Group Works	8	20%
Presentations	2	20%
Web Search	5	10%
Exams	2	40%
	Total	100%

ASSESSMENT

Evaluation Criteria	**Weight** (%)
Quizzes	15%
Weekly Assignments and Homework	15%
Presentations	20%
Attendance/Participation	10%
Mıdterm Exam	20%
Final Exam	20%
Total	100%

For a detailed description of grading policy and scale, please refer to the website https://goo.gl/HbPM2y section 28.

COURSE LOAD

Activity	**Duration** (hour)	**Quantity**	**Work Load** (hour)
Lectures	1	14	14
In class activities	1	14	14
Group work	1	8	8
Pre-work for presentation	16	2	32
Presentation	6	2	12
Homework	8	2	16
Research (web, library)	4	16	64
Required readings	4	16	64
Pre-work for Midterm	32	1	32
Midterm	3	1	3
Pre-work for Final	36	1	36
Final	3	1	3
		General Sum	**298**

ECTS: 10 (Work Load/25-30)

CONTRIBUTION TO PROGRAMME OUTCOMES*

	PO1	PO2	PO3	PO4	PO5	PO6
LO1	4	3	2	3	2	3
LO2	4	3	3	4	4	4
LO3	4	3	3	4	4	4
LO4	4	4	5	4	3	3
LO5	5	5	4	5	5	5

* Contribution Level: 0: None, 1: Very Low, 2: Low, 3: Medium, 4: High, 5: Very High

WEEKLY SCHEDULE

W	Topic	Outcomes
1	The course overview. Basic concepts and examples Activity: Lecture, Web search	LO1
2	Brief introduction to statistical thermodynamics Activity: Lecture, Web search	LO1
3	Single channel signals and their statistical analysis Activity: Lecture, group work	LO2
4	Multi-channel (vector) signals and their statistical analysis Activity: Lecture, group work	LO2
5	Review of computer tools for statistical analysis of signals Activity: Lecture, group work	LO4, L05
6	Real life applications of signal statistical analysis Activity: Lecture Free Week activity, Web search, group work	LO4, L05
7	Summary for signals Activity: Presentations, midterm exam	LO1, LO2, LO4, LO5
8	Basic concepts of networks Activity: Lecture, Web search	LO1, LO3
9	Statistical mechanics and thermodynamics of networks Activity: Lecture, group work	LO3
10	Phase transitions in networks Activity: Lecture, group work	LO3, LO5
11	Architecture of networks and their statistical mechanics analysis Activity: Lecture, group work	LO3
12	Review of computer tools for statistical analysis of networks Activity: Lecture, Web search	LO3, LO4
13	Application of network statistical models to real life Activity: Lecture, group work	LO3, LO5
14	Review of control methods for network statistical analysis Activity: Lecture, group work	LO3, LO5
15	Perspectives of statistical mechanics approach for the real life applications Activity: Lecture, presentations	LO5
16	Final Exam Activity: Final exam	LO1 – LO5

Prepared by
Assoc. Prof. Dr. Sergey Borisenok

Date
16/04/2018