

**Syllabus for the course “Fundamental ideas of network science” Fall Semester 2017**

1. Course Title: Fundamental ideas of network science
2. Lecturer: Prof. Janos Kertesz
3. No. of Credits (CEU/ECTS where applicable). 4 CEU credits.
4. Semester timing of the course: Fall 2017
5. Relationship with other courses: Basic course for the Network Science Certificate
6. Course Level: PhD
7. Background and overall aim of the course:

This is an interdisciplinary course and students with different backgrounds are expected to register for it. The aim is to get acquainted with the basic concepts of network science including elements of the theory of graphs, dynamics of and on networks as well as with applications from biology, sociology, economics and other fields. Mostly elementary math prerequisites are assumed, the tools needed will constitute part of the course.

8. The learning outcomes of the course. By successfully absolving the course the students will be able to:

- Recognize the importance of the network approach in their own fields of studies;
- Map out networks from data on complex systems in diverse fields of applications;
- Carry out statistical analysis of complex networks regarding the basic characteristics;
- Measure dynamic properties of processes on networks;
- Attend the more specialized courses

9. Detailed presentation of course contents:

| Week | 1st lecture              | 2nd lecture                  | Comments               |
|------|--------------------------|------------------------------|------------------------|
| 1    | Introduction             | Percolation                  |                        |
| 2    | Elements of graph theory | Visualizing and measuring    |                        |
| 3    | Random graphs            | Small worldness              | Assignment 1           |
| 4    | Scale freeness           | Configuration model          |                        |
| 5    | Network growth models    | Local structures             |                        |
| 6    | Communities              | Robustness and vulnerability | Assignment 2 (midterm) |
| 7    | Random diffusion         | Spreading phenomena          |                        |
| 8    | Temporal networks        | Controlling networks         |                        |
| 9    | Multiplex networks       | Signed networks              |                        |
| 10   | Social networks          | Mobility                     | WP article submission  |
| 11   | Internet and WWW         | Economics and finance        |                        |
| 12   | Ecological networks      | Project presentation         |                        |

10. Suggested reading:

**M.E.J. Newman: Networks – An Introduction (Oxford UP, 2010)**

**A.-L. Barabási: Network Science (Cambridge UP, 2016)**

J. P. Scott: Social Network Analysis: A Handbook (Sage Publications, 2004)

A. Barrat, M. Barthélemy and A. Vespignani: Dynamical Processes on Complex Networks (Cambridge UP, 2008)

D. Easley and J. Kleinberg: Networks, Crowds and Markets (Cambridge UP, 2010)

The pdf files of the lectures will be made available.

Teaching format:

The bulk of the course will be provided in lectures. There will be discussions of the tasks and the final projects will be presented by the students in a seminar form.

There will be two assignments. In addition a Wikipedia article in the field of complex networks has to be written. These tasks have to be tackled by the students independently. At the same time they are encouraged to form study groups. The final project should be prepared by pairs of students. There will be homework tasks.

11. Assessment:

- Assignments (assignment 1: 10%, assignment 2: 20%)
- Wikipedia article (20%)
- Final project (carried out individually (for CNS students) or in pairs (for others)) (40%)
- Teacher evaluation (10%, mostly based on homeworks)

12. Such further items as the course website (e-learning site), assessment deadlines, office hours, contact details etc.

The course has an e-learning site where materials about the lectures, homework, etc. are posted. It also serves for communication.