



Syllabus 2017 Applied Information Sciences Biomodeling

Japanese

Basic information

held this year:	yes
instructor(s)	Prof. M. Nakao & Asso. Prof. N. Katayama
room	206 Lecuture Hall, GSIS building
schedule	The first half year (Wednesday) 13:00-14:30
begins on:	04/12

Objectives and outline

From molecule to behavior, biological systems at the respective hierarchical levels are analytically modeled. Through these analytical modelings, functions of biological systems at each level and their integrative features are shown to be understood. Firstly, as fundamental tools for modeling and analysis of dynamics, theory of nonlinear dynamical systems and computer simulation are concisely explained. Then, structures of the models constructed in bottom-up and top-down ways are described, and computational and regulatory functions of their dynamics are explained as well.

Class plan

1. Fundamentals of Nonlinear Dynamics I
2. Fundamentals of Nonlinear Dynamics II
3. Fundamentals of Nonlinear Dynamics III
4. Quick Overview of Molecular Biology
5. Dynamics of Genetic Networks
6. Models of Genetic Networks
7. Physiology of Neuronal Excitation
8. Dynamics of Neuronal Excitation and Their Models
9. Bifurcation Structure of Neuronal Dynamics
10. Biological Rhythms
11. Biological Rhythms as Limit Cycle and Their Models
12. Entrainment of Biological Rhythm and Its Modeling
13. Pattern Formation and Self-organization
14. Reaction-Diffusion Model of Pattern Formation
15. Formal Models of Genesis and Development and Their Dynamics

Evaluation

Evaluation is done comprehensively based on short tests and essays.

Textbook(s)

Text: not used.

Related Literature:

- [1] T. Kohda, Chaos of Discrete Dynamics Systems, Corona Publishing Co., Tokyo, 1998.
- [2] R. Rosen, Dynamical System Theory in Biology I, John Wiley & Sons, New York, 1970.
- [3] D. Johnston and S.M. Wu, Foundation of Cellular Neurophysiology, MIT Press, Boston, 1995.
- [4] H. Honda ed., Mathematics and Physics of Biological Pattern Formation, Kyoritsu Publishing Co., Tokyo, 2000.
- [5] Y. Kuramoto et al., Pattern Formation, Asakura Publishing Co., Tokyo, 1991.
- [6] A.T. Winfree, The Geometry of Biological Time, Springer, New York, 2000.

Web site

<http://www.biomdl.ecei.tohoku.ac.jp/kata/biomdl/>

Office hours

By appointment only. Please inquire e-mail address and telephone number to the official in charge of education.

■ **Other information**

Students are required to review and prepare for each class based on the materials distributed in the class.

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