

## Syllabus

### 1. Course Title, style, and credit:

Membrane physiology and structure-function study of ion channels and receptors.

(X) Lecture, ( ) Discussions ( ) Practice]

1 credit

### 2. Appropriate grade level and Eligible Departments:

(x) 1, (x) 2, (x) 3, (x) 4, (x) 5:

(x) Department of Physiological Science, School of Life Science

### 3. Lecturer(s):

Yoshihiro Kubo

(ykubo@nips.ac.jp, Tel: 0564-59-5883 (will be changed in May), Yamate 3<sup>rd</sup> build 9F East (will be changed in May))

### 4. Time:

(oral) 10:00-12:00 on every Friday from May 11 – June 29, 2012

### 5. Place:

(oral) Seminar room B of the Yamate 3<sup>rd</sup> Building, 9<sup>th</sup> Floor

### 6. Prerequisites and Styles

This course begins with basic introduction of membrane physiology of excitable cells, and there is no lecture course especially requested to have been finished in advance. The entire course will be presented in English.

### 7. Contents:

Ion channels and receptors are important molecules underlying the excitability of neurons and their communication. In the 1st lecture, we will introduce the fundamental knowledge of general physiology, especially about the mechanisms of the resting potential and the generation of action potential. In the 2nd, we will explain about the molecular diversity and the function mechanisms of ion channels. In the 3rd – 6<sup>th</sup> and 8th lectures, we will introduce some unique and cutting-edge approaches to elucidate the structure-function relationship and the dynamics, including high speed atomic force microscopy analysis and single molecule X-ray diffraction analysis. In the 7th lecture, we will introduce simulation analyses of the functional dynamics of the cardiac pacemaker cell aiming at the qualitative understanding how cell function is achieved by integrating the function of membrane

proteins.

8. Course objectives:

- (1) To understand the mechanisms of the resting membrane potential and the generation of action potentials.
- (2) To understand the molecular diversity and the functioning mechanisms of ion channels and receptors.
- (3) To understand the detail and the significance of the various cutting-edge approaches to the dynamic structure-function relationship.
- (4) To acquire knowledge about the simulation analyses towards the quantitative understanding of the cell function by integrating the function of membrane proteins such as ion channels and receptors.

9. Schedule:

(1) May 11

Introduction of cell physiology, mechanisms of Membrane potential and generation of action potential

Yoshihiro Kubo (NIPS)

(2) May 18

Molecular diversity and mechanism of function of ion channels and receptors

Yoshihiro Kubo (NIPS)

(3) May 25

Cutting-edge approaches in the research of ion channels and receptors 1

-- Real time analyses of the dynamic structural rearrangements of various proteins by high speed atomic force microscope --

Toshio Andoh (Kanazawa Univ)

(4) June 1

Cutting-edge approaches in the research of ion channels and receptors 2

-- Subunit counting by single molecule live imaging --

Koichi Nakajo (NIPS)

(5) June 8

Cutting-edge approaches in the research of ion channels and receptors 3

-- Single particle structure analysis and crystal structure analyses by cryo EM --

Kazuyoshi Murata (NIPS)

(6) June 15

Cutting-edge approaches in the research of ion channels and receptors 4

-- Real time analyses of the structural rearrangements by single molecule X ray diffraction measurement --

Shigetoshi Oiki (Fukui Univ, Med, Physiology)

(7) June 22

Integration of the function of the membrane proteins towards cell function

-- reconstruction of the cardiac pace maker cell function by simulation

Satoshi Matsuoka (Kyoto Univ)

(8) June 29

Cutting-edge approaches in the research of ion channels and receptors 5

-- FRET analysis of the structural rearrangements of G protein coupled receptors --

Michihiro Tateyama (NIPS)

10. Lecture materials and readings

(1) Ion channels (by Aidley DJ and Stanfield PR), Cambridge Press, 1996

(2) Ion channels of excitable membranes 3<sup>rd</sup> Edition (by Hille B), Sinauer, 2001

11. Grades:

A theme based on the four course objectives will be presented by the lecturer at the end of the course. Students are requested to submit an essay report on the theme by the dead line. The grades will be determined by the quality of the report, and will be either "passed" or "failed".

12. Notes

Nothing particular