科目ナンバリング							
授業科目名<英訳>	ILAS Seminar-E2 :Introduction to condensed matter physical chemistry（固体と液体の物理化学入門） ILAS Seminar-E2 :Introduction to condensed matter physical chemistry			担当者所属職名・氏名	工学研究科　教授　山本　量一 工学研究科　准教授　谷口　貴志		
群	少人数群	単位数	2単位	週コマ数	1コマ	授業形態	ゼミナール（対面授業科目）
開講年度・開講期	2024・前期	受講定員(1回生定員)	10 (5) 人	配当学年	主として1回生	対象学生	全学向
曜時限	水5	教室	総合研究9号館西棟2階 W201と物理系校舎1階情報処理演習室1 (本部構内)			使用言語	英語
キーワード	condensed matter / soft material / statistical mechanics / computer simulation / dynamics						

[授業の概要・目的]

Through the students' own investigations and presentations on topics related to soft matter physics and chemistry in class, we enhance their interest in science and engineering of soft matters. In addition, through hands on experience, students will learn that computer simulations play an indispensable role in understanding and developing various materials.

[到達目標]

The goal of this class is for students to learn the fundamental ideas of statistical mechanics needed to understand various phenomena seen in soft materials. Students will use this knowledge to develop their own computer simulation codes, which they will then use to perform numerical experiments on a Soft Matter topic of their choice.

[授業計画と内容]

In 2017, Taniguchi will teach from 1 to 4 (7 weeks), and Yamamoto will teach from 5 to 11 (8 weeks).

1. What is Soft Matter? (class number of times: 2).
The Instructor gives an overview and various examples of soft matter and soft matter physics and chemistry in class
The instructor will assign a topic related to soft matter to each student.

2. Students' Presentation 1: (class number of times: 2).
Based on the students' own investigation, each student will give a presentation on the topic that was assigned to him/her in the previous class
(topics include viewpoints of Industrial applications, fundamental science, and selected interesting phenomena, etc.)

3. Computer simulations of soft materials 1 (class number of times: 2).
Overview of basic ideas and methods used in computer simulations of soft materials.
Keyword: (1) Monte Carlo method,
(2) Langevin dynamics,
(3) Molecular dynamics method, etc.

4. Students' Presentation 2: (class number of times: 1).

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Based on the students' own investigation, each student will give a presentation on the topic that was assigned to him/her in the previous class (regarding one of the computational methods, (1), (2) and (3) listed above).

5. Python programming for beginners: (class number of times: 1).
(1) Using Python, iPython, and Jupyter notebook
(2) Making graphs with matplotlib
(3) The Euler method for numerical integration
(4) Simulating a dumped harmonic oscillator

6. Distribution function and random number: (class number of times: 1).
(1) Stochastic variable and distribution functions
(2) Generating random numbers with Gaussian distribution
(3) The central limiting theorem
(4) Random walk

7. Brownian motion 1: basic theories: (class number of times: 1).
(1) Stochastic process
(2) Brownian motion and the Langevin equation
(3) The linear response theory and the Green-Kubo formula

8. Brownian motion 2: computer simulation: (class number of times: 1).
(1) Random force in the Langevin equation
(2) Python code to simulate Brownian motion
(3) Making animations

9. Brownian motion 3: data analyses: (class number of times: 1).
(1) More complicated stochastic processes
(2) Mean square displacement and diffusion constant
(3) Auto correlation function and spectral density

10. Distribution function for particle#700s position and velocity: (class number of times: 1).
(1) Getting financial data from markets using Python
(2) Auto correlation function and spectral density
(3) Own investigations on stochastic data

11. Students' Presentation 3: (class number of times: 1).
Based on the students' own investigation, each student will give a presentation on the background of the phenomenon he/she has chosen, and present the simulation results they have obtained when modeling the phenomena.

[履修要件]

It is requested that attendees have a basic understanding of ordinary differential equations and integral calculus.

[成績評価の方法・観点]

The grade will be determined by the evaluation of the presentations that will be performed by each student in class.

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[教科書]

使用しない

[参考書等]

（参考書）
授業中に紹介する

[授業外学修（予習・復習）等]

Based on the contents learned in the class, it is requested that attendees investigate themes assigned to each of them by the instructors and, in class, make presentations in English about the results obtained during their investigation.

[その他（オフィスアワー等）]