2020年度 物質科学特論A (4076)

■ 授業科目基本情報

科目区分	専門科目	**教職科目**	指定なし
単位数	1	**選択・必修・自由**	選択
授業形態	講義	**主な使用言語**	英語
開講時期	IV ビデオ収録された講義をアーカイブで視聴します。 アーカイブ公開予定日は2月9日です。	**履修登録システム**	使用する
履修登録期間	2020/12/21～2021/01/15	**履修取消期限**	2021/02/09

■ 教育プログラム別の履修区分

プログラム名	IS	CB	BS	BN	MS	CP	DS
履修区分	△	△	△	○	○	○	○
コア科目	–	–	–	–	–	–	–
履修方法	・修士論文研究又は特別課題研究を履修する場合は、基盤科目及び専門科目から12単位以上履修すること。 ・課題研究を履修する場合は、基盤科目及び専門科目から14単位以上履修すること。						

■ 授業科目概要

担当責任教員	柳田　健之
担当教員	(Hans-Dieter Bauer)、(Peter Dannenmann)、Jutta Kerpen、(Jochen Rau)
教育目的／学修到達目標	(1st, 2nd) (3rd, 4th) Microplastics are found in rivers, lakes, the sea and even in human food. Which is the impact of waste water treatment plants on microplastic pollution? (5th, 6th) Quantum computing is emerging as one of the key technologies of the 21st century. This course will introduce basic features of quantum physics, as well as some mathematical tools needed to describe them. With their help, the working principle of a quantum computer, of quantum simulation, and of secure quantum communication are explained. (7th, 8th) Simulation of technical or physical processes is an imprtant means to test and evaluate technical systems before they are built. In this class, we introduce basic principles of simulation technology using state-of-the-art simulation tools that are de-facto standard in industry. Relevant simulation techniques are conveyed using examples from the domains of physics and technology. These examples build on the topics taught in the previous sections of this lecture series.
授業概要／指導方針	(1st, 2nd) (3rd, 4th)In this lecture, the process technology of municipal waste water treatment is explained. Municipal waste water treatment plants eliminate more than 99 % of microplastics of the influent. Goal of this lecture is to understand the fundamentals of waste water treatment and the impact on microplastic emission. (5th, 6th) This lecture aims to raise awareness of the technological potential of quantum physics for computation, simulation, and secure communication. It provides some basic concepts and mathematical tools, and gives an overview of current research topics. The lecture is intended to encourage students to pursue further study in this field. (7th, 8th) In this lecture, a general overview of simulation techniques is given. Based on this overview, several specific methods used for simulating technical and physical systems (e.g. use of numerical integration techniques or modelling systems that contain feedback loops) are explained. After having attended this course, students are able to implement first simulation models of technical or physical systems by themselves.

■ 授業計画

[1限目 9:20-10:50] [2限目 11:00-12:30] [3限目 13:30-15:00] [4限目 15:10-16:40] [5限目 16:50-18:20] [6限目 18:30-20:00]

回数	日付 [時間]	担当教員	テーマ	内容
1	2/9 [1-6]	Prof. Hans-Dieter Bauer	Photosensitive / photoetchable glass: Micropatterning potential and recent developments towards diffractive optical elements ※Prof. Bauer's lecture has been cancelled.Alternative assignments will be given for credit. The assignment will be given later.	Photoetchable glasses have found broad interest during the MEMS hype in the 1990s. Nevertheless, there is not a huge variety of applications, due to the material's limited resolution and complicated etching procedure. In recent years, many investigations proofed that the material may be patterned by fs-lasers. Moreover, research is going on to explore the fundamental photochemistry with respect to the generation of diffractive optical structures. The talk gives an overview on this class of materials and presents own experimental results.
2	2/9 [1-6]	Prof. Hans-Dieter Bauer	Optical in-situ monitoring of the hydrogen desorption process of sodium alanate to develop a hydrogen level sensor for solid-state-based hydrogen storage systems ※Prof. Bauer's lecture has been cancelled.Alternative assignments will be given for credit. The assignment will be given later.	Complex alanates are a promising alternative for hydrogen storage. During the development of a fill-level sensor, which is based on attenuated total reflection on powder samples, a lot of parameters show influence on the desorption behavior and kinetics. Of course, temperature and pressure are most important, but also nucleation and grain size effects, pelletization procedure and cycling. The talk gives an overview on powder materials for storing hydrogen and shows results of our in-situ parallel measurements (desorbed mass and FTIR-ATR spectrum) measurement method which reveal new insights in the desorption kinetics, the cycling process, and preparation of the tank fill.
3	2/9 [1-6]	Prof. Jutta Kerpen	Biological Waste Water Treatment	Fundamentals of process technologies for biological waste water treatment; Conventional activated sludge system, membrane bioreactors, tertiary and quarternary treatment stage;
4	2/9 [1-6]	Prof. Jutta Kerpen	Microplastic - Elimination in Waste water Treatment Plants	origin of microplastics, biodegradibility and accumulation; sampling, sample preparation; identicfication of microplastics; elimination in municipal waste water treatment plants.
5	2/9 [1-6]	Prof. Jochen Rau	Basic Concepts of Quantum Theory	Experimental evidence for the breakdown of classical theory; reasoning about quantum experiments; mathematical description in Hilbert space; quantum bits and transformations; entanglement
6	2/9 [1-6]	Prof. Jochen Rau	Quantum Computation and Communication	quantum logical gates and circuits; Deutsch algorithm; BB84 quantum key distribution; optimization problems
7	2/9 [1-6]	Prof. Peter Dannenmann	Basics of Simulation Technology	Overview of simulation techniques; distinction between continuous, quasi-continuous and discrete simulation; system modelling life cycle; modelling principles; dealing with differential equations within simulation models; numierical integration techniques; modelling systems with feedback.
8	2/9 [1-6]	Prof. Peter Dannenmann	Specific modelling techniques	Developing mathematical models of a specific application problem; methods for implementing the mathematical models in state-of-the-art simulation tools; implementing a simulation model of a physical or technical system.

■ 授業日程

[1限目 9:20-10:50] [2限目 11:00-12:30] [3限目 13:30-15:00] [4限目 15:10-16:40] [5限目 16:50-18:20] [6限目 18:30-20:00]

回数	日付	時間	講義室	備考
1	2/9	終日	使用しません	Bauer先生の講義は中止となりました。単位認定のために、別途課題を指示します。
2	2/9	終日	使用しません	Bauer先生の講義は中止となりました。単位認定のために、別途課題を指示します。
3	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。
4	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。
5	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。
6	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。
7	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。
8	2/9	終日	使用しません	ビデオ収録された講義をアーカイブで視聴します。アーカイブ公開予定日は2月9日です。

■ テキスト・参考書

テキスト	(5th, 6th) Leonard Susskind, Quantum Mechanics: The Theoretical Minimum, Penguin Valerio Scarani, Chua Lynn, Liu Shi Yang, Six Quantum Pieces, World Scientific (7, 8th) Averill M. Law: Simulation Modeling and Analysis, ISBN-10: 0073401323, ISBN-13: 978-0073401324, McGraw-Hill Science/Engineering/Math; 5th edition, 2014 Francois E. Cellier, Ernesto Kofman: Continuous System Simulation, ISBN-10: 3540389075, ISBN-13: 978-3540389071, ASIN: 0387261028, Springer, 2006
参考書	(3rd, 4th) Microplastic pollutants, Christopher Blair Crawford and Brian Quinn,Elsevier Science, 2016 (5th, 6th) Nielsen and Chuang, Quantum Computation and Quantum Information, Cambridge University Press (7, 8th) Harold Klee, Randal Allen: Simulation of Dynamic Systems with MATLAB and Simulink, Second Edition, ISBN-10: 1439836736, ISBN-13: 978-1439836736, CRC Press, 2011

■ その他

履修条件	None
オフィスアワー	Will not be set up.
成績評価の方法と基準	・Evaluated as S, A, B, C, or D ・Evaluated by submitted reports describing short essays on each professors' questions which will be informed to attending students by email.
関連科目	None
関連学位	Science、Engineering、Biological Science
注意事項	None