UNIVERSITÄT BAYREUTH

INTERNATIONAL OFFICE

General Overview of English-taught courses at the University of Bayreuth

Available during the Summer Semester 2023

An overview for the winter semester 2023/24 is expected to be available as of 01.10.2023

Mathematics, Physics and Computer Science

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
576	Current Topics in Complex Systems	S		2	
777	Large Master Project (Data-driven Optimal Control of Volumetric Displays)	P	15	2	
839	Bachelor Practical Training (INF 105) (Registration for all chairs)	PT	6-7	2	
10110	Introduction to Iterative Methods in Numerics	L & E	8	2	Only a fraction of the mathematical problems arising in practice can be solved analytically • the majority cannot be mastered with paper and pencil. For example, not even the pendulum motion of a thin rod can be given in closed form. Another example results from the theorem of Abel-Ruffini. According to this theorem, there is no closed calculation formula for eigenvalue problems of dimension 5 or larger. In order to be able to solve already such simple problems, iterative numerical methods are indispensable. For more complex problems, the computer is used as an aid for the implementation of the corresponding numerical methods.
10201	Ergodic theory and data science	L & E	10	6	Ergodic theory deals with the long-term behaviour of dynamical systems and makes statistical statements about it. It allows us to make statistical predictions about otherwise unpredictable systems, such as chaotic or nondeterministic systems. A central role is played by the so-called transfer operator, which describes the evolution of distributions under dynamics. We will pay special attention to the numerical computation and data-based approximation of the relevant objects.
10207	Algorithmic Graph Theory	L & E	10	2	
10211	Numerical Methods for General Types of PDEs	L & E	8-10	6	This module is the continuation of the module "Numerical Methods for Differential Equations". It is focused on the numerical solution of more general types of partial differential equations arising from realistic applications such as fluid dynamics, electromagnetism, structural mechanics, etc.
10214	Modelling, simulation and optimisation with ordinary differential equations	L & E	10	2	Mathematical modeling of application problems with certain DGL (e.g. disease modeling, ...) Numerical methods for initial value problems with certain DGL (convergence theory, one-step method, step size control, stiff DGL) Optimization methods for DGL (formulation, discretization in a nonlinear optimization problem) Boundary value problems of a stiff DGL (shooting method, collocation method)
10234	Mathematical Modeling for Climate and Environment	L & E	5-10	6	Course topics: Physical principles, mathematical models, and numerical methods in climate and environmental sciences • Earth system: Main components, driving forces, scales, feedbacks • Hierarchy of climate models, regional and global focus • Environmental
10241	Probability Theory	L & E	10	6	Selected topics in advanced probability theory and topics in stochastic processes: *characteristic functions* random elements in metric spaces • Markov Processes • Markov Chains • Metrics on the Set of Probability Measures
10303	Efficient treatment of non-local operators	L & E	8-10	6	State-of-the-art linear complexity treatment of partial differential and integral operators and parallelization techniques: fast multipole methods for the efficient treatment of multi-source potentials (one of the TOP10 algorithms from the 20th century) hierarchical matrices (for the treatment of non-local operators with linear complexity) • Schwarz methods (additive and multiplicative) • BPX preconditioner • Domain decomposition (overlapping and non-overlapping), BPS and Neumann-Neumann preconditioners, FETI
10602	Modeling Seminar A Presentation	AS	8	2	Students receive real-world projects and work (in small groups) their way into them. The seminar is divided into two parts: Presentation and Written Report.
10603	Modeling Seminar A Report	AS	8	2	Students receive real-world projects and work (in small groups) their way into them. The seminar is divided into two parts: Presentation and Written Report.
10604	Modeling Seminar B Presentation	AS	8	2	Students receive real-world projects and work (in small groups) their way into them. The seminar is divided into two parts: Presentation and Written Report.

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
10605	Modeling Seminar B Report	AS	8	2	Students receive real-world projects and work (in small groups) their way into them. The seminar is divided into two parts: Presentation and Written Report.
10609	Seminar Scientific Computing	AS		2	
10610	Pre-course Scientific Computing	L & E		2	Analytical concepts: normalized spaces, convergence, closed and compact sets, Banach and Hilbert spaces, Lp spaces. Numerical methods: Interpolation, quadrature rules, LU and QR decomposition, conjugate gradient methods Programming in C/C++: Implementation of CG with std::vector and BLAS • compiling, debugging and linking from the Linux command line and via cmake/make
10611	Modelling with differential equations	L & E	4	2	
10809	Mathematical specialisations for economics	L & E	5-6	4	Mathematical methods from linear algebra, analysis and optimisation for economic and business problems are deepened.
10874	Crystallography In Superspace	L & E	6-9	2	crystalline order of matter, the higher-dimensional superspace approach, symmetry, crystal-chemical structure analysi
12003	Information Visualization	L	5	2	Introduction to Information Visualization (e.g. motivation, examples, core concepts) • Specific visualization types and data types (e.g. multi-dimensional, graphs, hierarchies and trees, time series, text-related, etc.) • Interaction with information visualizations • Presentation, integration and evaluation of information visualizations • Practical implementation of information visualizations (e.g. Python, web-based and other frameworks)
12013	Intelligent User Interfaces	L	5	2	Introduction to Intelligent User Interfaces (e.g. motivation, examples, core concepts) • HCI + AI recap/ preparations (e.g. basic concepts • practical prototyping with Python (backend, AI, algorithms) and JS/HTML/CSS (user interface, interaction)) • Recommender systems (e.g. movie recommendations) • Conversational user interfaces (e.g. chatbots, voice assistants) • Interaction with text (e.g. personalised keyboards, text suggestions, language modelling) • User/input modelling and adaptive UIs (e.g. touch, pointing, typing, menus) • Computational UI design and evaluation (e.g. layout optimisation) • Broader perspective (e.g. explainable AI, ethics) x000D
12015	Intelligent User Interfaces – Exercise	E		2	
12016	Information Visualisation – Exercise	E		2	
12108	Event Processing (INF 222)	L	5	2	Foundations • Data flow model • Windowing • Parallel processing • Optimization • Fault tolerance • Approximation • Incremental processing.
12119	Programming, Data Analysis and Deep Learning in Python	L	5-14	2	The Python programming language, data types, control structures, functions, object-oriented programming, debugging. Programming, Debugging. Algorithms: Recursion, dynamic programming, Newton's method. Calculating with matrices: Linear algebra with NumPy, matrix factorizations, eigenvectors and -values, diagonalization, SVD. values, diagonalization, SVD, least squares method, pseudoinverse. Data analysis: pandas, clustering, plotting. Neural networks and deep learning.
12200	Data Analysis II	L	8	2	Data Visualisation, Machine Learning, Ontologies, NoSQL, Distributed Computing Concepts (MapReduce, Hadoop, etc.)
12201	Robotics II	L	5	2	Collision detection, local path planning, configuration space, potential fields, path maps, cell maps, sampling algorithms, Kalman filtering, Bayes filtering.
12220	Foundations of Semi-structured Data	L	5	2	Data on the Web is present in many different forms. The most widespread formats are tabular (csv), tree-structured (XML, JSON), and graph-structured (RDF, knowledge graphs, property graphs). Tabular data is *similar in spirit* to relational databases, which is treated in depth in DBIS 1. This lecture focuses on foundational aspects of the other data models, namely tree- and graph structured data.
14054	Advanced Physical Computing (PBWP6)	L	3-5	2	advanced computational methods, such as Laplace transform, Laurent series, asymptotic evolution, selected topics in complex analysis, functional analysis, group theory, etc.

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
14077	Crystallography in Solid State Physics	L & E	6-15	4	This course explores different manifestations of resistance and revolution in order to reflect on the idea of social change. How does change happen? What/who makes it happen? Why do we tend to think of change in terms of a positive, desirable development? We will reflect on these and related questions drawing on a variety of ethnographic works: from grassroots, small-scale "rituals of rebellion" to trans-national movements and global revolutionary agendas.
14087	Methods of molecular simulation	L & E	15	2	In the lecture, the most important ecological processes for the vegetation of the earth are presented. The lecture conveys that both biophysical laws and the evolutionary history of individual sites are necessary to understand vegetation patterns. Topics include, for example, the carbon balance of leaves, plant canopies and vegetation, carbon allocation, birth and mortality, and the structure of plant com-munities and ecosystems. The seminar examines case studies from the application of dynamic global vegetation models (DGVMs, "Dynamic Global Vegetation Models") based on original works.
14250	Advanced Concepts and Current Topics in Biological Physics (B1: Modelling and design of protein structures)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14253	Advanced Concepts and Current Topics in Biological Physics (B4: Visualization of cell organelles: dynamics and ultrastructure)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14260	Advanced Concepts and Current Topics in Biological Physics (P1: Biofluid simulations)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14262	Advanced Concepts and Current Topics in Biological Physics (P3: Single-molecule techniques in Biophysics)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14264	Advanced Concepts and Current Topics in Biological Physics (P5: Calculating ex-citations in molecular systems)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14265	Advanced Concepts and Current Topics in Biological Physics (P6: Quantifying transport and binding events in living organisms)	L & E	10 / 2 ECTS	2	As part of the module, special courses from the fields of biochemistry, molecular biology, experimental physics and theoretical physics are offered for the elite study programme. A minimum number of these must be completed successfully as specified in App. 1.
14270	Interdisciplinary Practical Training Biological Physics	PT	12	2	
14361	Physics Colloquium	Cq		2	
15032	Review of Current Scientific Literature	L		2	
15064	Synchrotron Radiation and the X-Ray Free-Electron Laser	L	6-12	2	Construction and operation of a synchrotron • the free electron laser (FEL) • properties of synchrotron radiation and of radiation from an X-ray laser • applications in biological physics and in solid-state physics.
15140	Modern crystallographic methods	S		2	

Key/Abbreviations:

AS Advanced Seminar
Cs Course
Cq Colloquium
E Exercise
ECTS Credit Points
L Lecture
P Project
PT Practical Training
S Seminar

Please check availability of your chosen subject/course by contacting the respective faculty.

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