UNIVERSITÄT BAYREUTH

INTERNATIONAL OFFICE

General Overview of English-Taught Courses at the University of Bayreuth

Available during the Winter Semester 2023/24

An overview for the summer semester 2024 is expected to be available as of 01.04.2024

Mathematics, Physics and Computer Science

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
00873	Advanced Concepts and Current Topics in Biological Physics (B4:Visualization of cell organelles: dynamics and ultrastructure)	Le & Tu	2	1	
14264	Advanced Concepts and Current Topics in Biological Physics (P5: Calculating excitations in molecular systems)	Le & Tu	2	1	Topic as part of the course Advanced Concepts and Current Topics in the Elite Graduate Programme "Biological Physics". Block course after prior registration. Time and place to be announced.
12322	Applied AI for biomedical and biophotonic data	Le	-	2	Static tests for biomedical tasks; classical machine learning models and their application; image-based data processing and their modelling using classical machine learning.
10343	Arithmetic of hyperelliptic curves	Le & Tu	5	3	A hyperelliptic curve C is given by an equation of the form y^2 = f(x), where f is a polynomial with no multiple zeros of degree at least 5. We will mainly deal with the case where f has integer coefficients. In this case, we can speak of rational points on C; these are points with rational coordinates (x,y) that fulfil the curve equation (and possibly one or two points "at infinity"). It follows from a famous theorem by Faltings that there are only a finite number of rational points on C. The lecture will focus on how to determine this finite set for a given curve.
00464	Current Topics in Complex Systems	S	-	2	
12205	Data Analysis I	Le	-	2	Database concepts for large, distributed applications: Multicomputer database systems (shared nothing or shared disc architectures), data warehouse systems (cube model, implementation, access paths); data mining (association, clustering, classification); special applications of databases in the fields of bioinformatics, engineering and environmental informatics. Concepts of modern software development for web-based information systems (development of web-based application systems): Development methods of web-based application systems; techniques for developing web-based application systems: Web services, component technologies, security aspects, semantic web; special web technologies for the fields of bio-, engineering and environmental informatics Advanced modelling: modelling; meta-modelling, advanced modelling patterns; domain-specific modelling and languages; frameworks for modelling (EMF, MOF, UML); evolution of models and meta-models (modelling languages), process modelling. The intensive exercise picks up on important contents of the lectures and deepens them.
12320	Deep Learning (DL)	Le	-	2	Artificial Neural Networks (ANNs), Multilayer Perceptrons (MLPs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short Term Memory Networks (LSTMs), Autoencoder, Generative Adversarial Networks (GANs), Digital Pathology, Natural Language Processing.
00206	Discontinuous Galerkin finite element methods: formulation, analysis, applications (Discontinuous Galerkin finite element methods: Formulation, analysis, applications)	Le & Tu	4	3	The discontinuous Galerkin (DG) methods are a special type of Finite Element methods, which rely on the globally discontinuous approximation spaces. They combine the most attractive features of the classical Finite Element and Finite Volume methods and serve as the foundation for a whole range of new discretisation schemes. The analysis of DG methods uses special extensions of standard Sobolev space techniques well known from the Finite Element analysis. This course offers an introduction into the DG methods for hyperbolic and parabolic partial differential equations. In a series of programming exercises, the course participants will implement DG discretisations for one- and two-dimensional problems.
10104	Introduction to geometry: projective and algebraic geometry	Le & Tu	8	5	This lecture is intended to give a first impression of various areas of geometry, mainly using tools from linear algebra. The basics of projective and affine geometry (e.g. the main theorem of projective geometry, classification and geometric properties of quadrics, the classical theorems of Desargues, Pappos and Pascal) will be covered, and an insight into the beginnings of algebraic geometry will be given. Plane algebraic curves (tangents, singularities, inflection points, Bézout's theorem and linear systems) are dealt with. Essentially, the techniques learnt in the beginners' lectures from linear algebra are applied to geometry. No further prior knowledge is required. This course is recommended for all students who wish to specialise in a sub-area of geometry, as well as for student teachers who will teach geometry at school.
12317	Foundations of Data Management	Le	4	2	This course will make you familiar with the mathematical principles of databases. We want to give you an understandable, mathematically clean, and elegant view of how data is managed and queried. The course focuses on relational database systems, which have been tremendously successful and remain the dominant data management technology today. The course is not aimed at teaching you how to use SQL, but is aimed at teaching you on a deeper level what are the connections between SQL, logic, query plans, and efficient algorithms for evaluating queries.

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
12112	Graph Processing and Machine Learning (GPML)	Le	-	2	Basics, graph problems, graph algorithms, graph analysis, pattern matching, knowledge graphs, graph databases, machine learning on graphs, graph neural networks, graph processing frameworks
14070	Fundamentals of Crystallography (PBWP4)	Le	5	4	Point groups, space groups, group theory; phase transformations; tensor properties; X-rays; interaction of X-rays and matter; X-ray diffraction; Fourier maps; Patterson function; charge flipping; maximum entropy method (MEM).
10344	Groups and Representation Theory	Le & Tu	5	3	This lecture deepens the introductory course in algebra. Advanced concepts of group and representation theory are covered, in particular cohomological methods and projective representations.
14270	Interdisciplinary Practical Exercise Course Biological Physics	Cs	12	6	
00642	Small Master Project (Creating Intelligent Interactive Systems)	Pro	8	6	In this practical course, students develop interactive systems that support users in everyday situations by making use of smartphone sensors (e.g. camera, microphone, accelerometer, ...) and Machine Learning to realise "intelligent" features. The course starts with an introduction to Android with individual assignments. Later, students work in small teams to develop and implement a prototype app and test it with potential users. The course requires no special prior knowledge apart from solid programming skills. However, students are expected to bring high self-motivation to learn and work at the intersection of Human-Computer-Interaction and applied Machine Learning / AI. Due to the current situation, the course will be held online with weekly meetings via zoom, plus video content and other material.
14058	Collective Phenomena in Solids (MGP)	Le	6	4	
10300	Complexity reduction in control theory	Le & Tu	4	3	In this lecture we will cover two basic methods for complexity reduction: Firstly, we will discuss reduced basis methods that can be used to reduce the size of a control system, sometimes substantially, with only an insignificant change in its behaviour. On the other hand, we will look at methods with which model predictive control can be carried out purely on the basis of data without creating a model.
00069	Modern methods of high-pressure materials research	S	-	2	
10532	Advanced seminar "Arithmetic Geometry"	S	-	2	Advanced seminar of the research groups Algorithmic Arithmetic Geometry (Stoll) and Number Theory (Dettweiler).
10608	Parallel Numerical Methods	Lab	2	2	In this practical course, students implement manageable numerical problems (such as Gaussian elimination, finite element discretisation of 2d Laplacian, etc.) on parallel computers using the programming language C/C++ and standard software libraries (LAPACK/BLAS, OpenMP, OpenMPI). The resulting parallel efficiency is observed depending on the chosen implementation (naive or advanced such as Schwarz methods).
14074	Polymer Physics	Le	6	4	
14075	Polymer Physics (supplements)	S	-	2	
12119	Programming, Data Analysis and Deep Learning in Python	Le	5	2	The Python programming language, data types, control structures, functions, object-oriented programming, debugging. Algorithms: Recursion, dynamic programming, Newton's method. Arithmetic with matrices: Linear algebra with NumPy, matrix factorisations, eigenvectors and -values, diagonalisation, SVD, least squares method, pseudo inverse. Data analysis: pandas, clustering, plotting. Neural networks and deep learning.
12018	Programming, Data Analysis and Deep Learning in Python - Intensive Exercise (Scientific Python Clinic))	Tu	-	2	The Python programming language, data types, control structures, functions, object-oriented programming, debugging. Algorithms: Recursion, dynamic programming, Newton's method. Arithmetic with matrices: Linear algebra with NumPy, matrix factorisations, eigenvectors and eigenvalues, diagonalisation, SVD, least squares method, pseudo inverse. Data analysis: pandas, clustering, plotting. Neural networks and deep learning.
00083	Review of current scientific literature	Le	-	2	
15031	Seminar: Fundamentals of crystal structure analysis	S	-	2	
15030	Seminar: Modern Crystallographic Methods	S	-	2	
10606	Status Seminar A	Ad. S	-	2	Each student prepares a presentation on the status of his/her studies and results of his/her research (duration: 15-30 minutes) and talks about it in front of the plenum.

Number	Course Title	Type	ECTS / Credits	Duration	Module Description
10607	Status Seminar B	Ad. S	-	2	Each student prepares a presentation on the status of his/her studies and results of his/her research (duration: 15-30 minutes) and talks about it in front of the plenum.
12159	Theoretical Computer Science II	Le	5	2	In this lecture we will take a more precise look on computational complexity. This means that we will (1) study time and space complexity of problems, (2) study how these relate to each other, and (3) study what these have to do with logic. By doing so, we will dive into the very nature of computing, shed light on some very fundamental issues, and touch upon some of the biggest unsolved problems that Computer Science has to offer.
12321	Tutorial on Deep Learning (DL)	Tu	-	1	
12007	Tutorial on User-centred design (formerly MCI)	Tu	-	1	The course introduces the basics of human-computer interaction. The focus is on graphical user interfaces and corresponding input mechanisms. The course primarily serves to acquire technological skills
12160	Tutorial on Theoretical Computer Science II	Tu	-	1	Students should acquire in-depth knowledge in the areas of logic and complexity theory and understand the links between the two areas. They should be able to apply the knowledge from the lecture in exercises.
12006	User-centred design (formerly MCI)	Le	6	2	The course introduces the basics of human-computer interaction. The learning objectives are: - Theoretical understanding of the design process of interactive systems. - The ability to carry out a user-centred design process for an interactive system.
15906	Advanced practical course	Lab	-	10	
00087	Advanced seminar on powder X-ray diffraction	S	-	2	
10610	Preliminary course in Scientific Computing	Le & Tu	2	2	- Analytical concepts: normalised 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++: Implemen

Key/Abbreviations:

Ad.S	Advanced seminar	Le	Lecture
Cs	Course	Pro	Project
ECTS	Credit Points	S	Seminar
Lab	Lab course	Tu	Tutorial

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

You can find contact details at www.uni-bayreuth.de/en/study

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