Degree: **M.Sc. in Physics (PO von 2014)**

Module No.: physics61c
Credit Points (CP): 7
Category: Elective
Semester: 1.

Fachgruppe
Physik und Astronomie
Universität Bonn

Module: Specialization: Theoretical Physics

Module Elements:

Nr.	Course Title	Number	CP	Type	Workload	Sem.
Theoretical Physics						
1.	Theoretical Particle Physics	physics615	7	Lect. + ex.	210 hrs	WT
2.	Theoretical Hadron Physics	physics616	7	Lect. + ex.	210 hrs	WT
3.	Theoretical Condensed Matter Physics	physics617	7	Lect. + ex.	210 hrs	WT
4.	Solid State Theory I	TheoSolidSt	6	Lect. + ex.	180 hrs	WT

Requirements for Participation:

Form of Examination:
see with the course

Content:
Fundamentals in theoretical physics in Bonn or Cologne

Aims/Skills:
Mit den Spezialisierungsvorlesungen wird die Möglichkeit eröffnet, sich in einer bzw. mehreren der in Bonn vertretenen Forschungsrichtungen zu spezialisieren.
The students will get acquainted with modern research topics

Course achievement/Criteria for awarding cp's:
see with the course

Length of Module: 1 semester

Maximum Number of Participants: ca. 100

Registration Procedure:
s. https://basis.uni-bonn.de u. http://bamawww.physik.uni-bonn.de

Note: The student must achieve at least 24 CP out of all 6 Specialization Modules

Module: Specialization: Theoretical Physics

Module No.: physics61c

Course: Theoretical Particle Physics

Course No.: physics615

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+2	7	WT

Requirements for Participation:

Preparation:
Advanced quantum theory (physics606)
Quantum field theory (physics755)
Group theory (physics751)

Form of Testing and Examination:
Requirements for the examination (written): successful work with the exercises

Length of Course:
1 semester

Aims of the Course:
Introduction to the standard model of elementary particle physics and its extensions (unified theories)

Contents of the Course:
Classical field theory, gauge theories, Higgs mechanism;
Standard model of strong and electroweak interactions;
Supersymmetry and the supersymmetric extension of the standard model;
Grand unified theories (GUTs);
Neutrino physics;
Cosmological aspects of particle physics (dark matter, inflation)

Recommended Literature:
T. P. Cheng, L.F. Li: Gauge theories of elementary particle physics (Clarendon Press, Oxford 1984)
M. E. Peskin, D.V. Schroeder; An introduction to quantum field theory (Addison Wesley, 1995)
J. Wess; J. Bagger; Supersymmetry and supergravity (Princeton University Press 1992)

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Course: Theoretical Hadron Physics

Course No.: physics616

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+2	7	WT

Requirements for Participation:

Preparation:
Advanced quantum theory (physics606)
Quantum field theory (physics755)
Group theory (physics751)

Form of Testing and Examination:
Requirements for the examination (written): successful work with the exercises

Length of Course:
1 semester

Aims of the Course:
Introduction to the theory of strong interaction, hadron structure and dynamics

Contents of the Course:
Meson and Baryon Spectra: Group theoretical Classification, Simple Quark Models
Basics of Quantum Chromodynamics: Results in Perturbation Theory
Effective Field Theory
Bethe-Salpeter Equation

Recommended Literature:
F. E. Close, An Introduction to Quarks and Partons (Academic Press 1980)
F. Donoghue, E. Golowich, B.R. Holstein; Dynamics of the Standard Model (Cambridge University Press 1994)
C. Itzykson, J.-B. Zuber; Quantum Field Theory (Dover Publications 2005)
S. Weinberg; The Quantum Theory of Fields (Cambridge University Press 1995)

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Course: Theoretical Condensed Matter Physics

Course No.: physics617

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+2	7	WT

Requirements for Participation:

Preparation:
Advanced Quantum Theory (physics606)
Quantum Field Theory (physics755)
Group theory (physics751)

Form of Testing and Examination:
Requirements for the examination (written): successful work with the exercises

Length of Course:
1 semester

Aims of the Course:
Introduction to the theoretical standard methods and understanding important phenomena in the Physics of Condensed Matter

Contents of the Course:
Crystalline Solids: Lattice structure, point groups, reciprocal lattice
Elementary excitations of a crystal lattice: phonons
Electrons in a lattice; Bloch theorem, band structure
Fermi liquid theory
Magnetism
Symmetries and collective excitations in solids
Superconductivity
Integer and fractional quantum Hall effects

Recommended Literature:
N. W. Ashcroft, N.D. Mermin, Solid State Physics (Saunders College 1976)
P. M. Chaikin, T.C. Lubensky; Principles of Condensed Matter Physics (Cambridge University Press 1997)
W. Nolting; Grundkurs Theoretische Physik Band 7: Vielteilchentheorie (Springer, Heidelberg 2002)
Ch. Kittel; Quantentheorie der Festkörper (Oldenburg Verlag, München 3. Aufl. 1989)

Module: Specialization: Theoretical Physics

Module No.: physics61c

Course: Solid State Theory I

Course No.:

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+1	6	WT

Requirements for Participation:

Preparation:
training in theoretical physics at the B.Sc. level, experimental solid state physics

Form of Testing and Examination:
written or oral examination

Length of Course:
1 semester

Aims of the Course:
this course gives an introduction to the physics of electrons and phonons in solids together with theoretical concepts and techniques as applied to these systems.

Contents of the Course:
The lecture investigates basic concepts to describe solids and their excitations. Various applications are discussed with emphasis on experimental and theoretical research directions of the physics department in Cologne.

Recommended Literature:
Ashcroft/ Mermin: "Solid State Physics"