Degree: **M.Sc. in Physics (PO von 2006)**

Module No.:	physics605
Credit Points (CP):	7
Category:	Required
Semester:	7.

Fachgruppe Physik und Astronomie Universität Bonn

Module: Base Module Theoretical Physics

Module Elements:

Nr.	Course Title	Number	CP	Type	Workload	Sem.
1.	Advanced Quantum Theory	physics606	7	Lect. + ex.	210 hrs	WT
2.	Advanced Theoretical Physics	physics607	7	Lect. + ex.	210 hrs	WT

Requirements:

Preparation:

Content:
The course provides fundamental knowledge needed for theoretical lectures in the Master course

Aims/Skills:
The M.Sc. Physics programme includes one obligatory module for all students. It includes a theoretical unit to extend the B.Sc. in Physics knowledge

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

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: When the student has (upon admission) demonstrated satisfactory knowledge of Advanced Quantum Theory already, the class Advanced Theoretical Physics may be taken instead

Module: Base Module Theoretical Physics

Module No.: physics605

Course: Advanced Quantum Theory

Course No.: physics606

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

Requirements:

Preparation:
Theoretical courses at the Bachelor degree level

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

Length of Course:
1 semester

Aims of the Course:
Ability to solve problems in relativistic quantum mechanics, scattering theory and many-particle theory

Contents of the Course:
Born approximation, partial waves, resonances
advanced scattering theory: S-matrix, Lippman-Schwinger equation
relativistic wave equations: Klein-Gordon equation, Dirac equation
representations of the Lorentz group
many body theory
second quantization
basics of quantum field theory
path integral formalism
Greens functions, propagator theory

Recommended Literature:
L. D. Landau, E.M. Lifschitz; Course of Theoretical Physics Vol.3 Quantum Mechanics (Butterworth-Heinemann 1997)
J. J. Sakurai, Modern Quantum Mechanics (Addison-Wesley 1995)
F. Schwabl, Advanced Quantum Mechanics. (Springer, Heidelberg 3rd Ed. 2005)

Module: Base Module Theoretical Physics

Module No.: physics605

Course: Advanced Theoretical Physics

Course No.: physics607

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

Requirements:

Preparation:
3-year theoretical physics course with extended interest in theoretical physics and mathematics

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

Length of Course:
1 semester

Aims of the Course:
Introduction to modern methods and developments in Theoretical Physics in regard to current research

Contents of the Course:
Selected Topics in Modern Theoretical Physics for example:
Anomalies
Solitons and Instantons
Quantum Fluids
Bosonization
Renormalization Group
Bethe Ansatz
Elementary Supersymmetry
Gauge Theories and Differential Forms
Applications of Group Theory

Recommended Literature:
M. Nakahara; Geometry, Topology and Physics (Institute of Physics Publishing, London 2nd Ed. 2003)
R. Rajaraman; Solitons and Instantons, An Introduction to Solitons and Instantons in Quantum Field Theory (North Holland Personal Library, Amsterdam 3rd reprint 2003)
A. M. Tsvelik; Quantum Field Theory in Condensed Matter Physics (Cambridge University Press 2nd Ed. 2003)
A. Zee; Quantum Field Theory in a Nutshell (Princeton University Press 2003)