Fachbereich Mathematik
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PrepCourse: Concepts and Methods of Mathematical Physics

When?

October 7th - 11th, 2013.

Mo-Fr, 10.00 am - 12:30 pm and 1:30 pm - 4:00 pm (each with a 15 min break)

Where?

Geomatikum H3, Bundesstraße 55

For Whom?

The one-week PrepCourse is aimed at Master or Diploma students in Mathematics or Physics who wish to attend courses in the Mathematical Physics M.Sc. Program during the fall term 2013 / 2014. The course serves as a preparation for the above program. It is also suitable for students finishing a Bachelor in Mathematics or Physics. Lectures and Tutorials will be presented in English.

Content and topics

The aim of the PrepCourse is to introduce and refresh fundamental concepts and methods of Mathematical Physics. The PrepCourse proceeds along the following topics, while a special focus may be chosen according to interests and background of the participants. Each topic lecture will be followed by active problem-solving of the participants and application to physical examples:

Linear Algebra: Basics (vectorspace, duals, tensor product). Jordan normal form. Eigenvalue theory in application to simple finite quantum mechanics systems.

Analysis: Basics (convergence, derivative, integral, manifold, differential form). Integration over submanifolds, coordinate transformation, metric tensor. Stokes theorem in general and it's low-dimensional cases with physical interpretation (e.g. Gauss). Outlook to the de-Rham complex in this setting (grad, rot, div), conservative fields, scalar- and vector-potential.

Function spaces: Basics (top. vector space, Hilbert spaces, Fourier analysis). Differential equations (forced oscillation, coupled systems). Eigenvalues of differential operators (Heat equation, Wave equation) with physical applications and examples (e.g. vibrating membrane, but mostly quantum mechanics: Schrödinger equation, spherical harmonics etc.)

Symmetry groups: Basics (category, group). Matrix Lie groups with example Lorentz group and covering (boson vs. fermion). Lie algebra and representations in examples, also on a function space (impulse operator). Tensoring representations, Clebsch-Gordan and the explicit example in spin-orbit-coupling.