MATH 80870: Topics in Mathematical Physics
Introduction to quantum mechanics

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Fall 2014
MWF 10:30–11:20

This course is an introduction to the ideas of quantum mechanics, from a mathematical perspective. Ideas from quantum mechanics permeate many parts of mathematics, including, notably, representation theory and topological invariants of manifolds and knots. It is, however, difficult for mathematicians to learn about quantum mechanics from the physics literature, because of differences in background and style. The course does not assume any prior knowledge of physics, but will begin with a brief treatment of classical mechanics before proceeding on to quantum mechanics. We will explore both the physical ideas of quantum mechanics and the mathematical foundations.

I will be teaching from my recent book on the subject, Quantum Theory for Mathematicians. I will not be able to cover the whole book and the precise choice of topics will be based on the interests of the class. We cover at least (1) elementary classical mechanics, (2) the basics of quantum mechanics, including operators, expectation values, and the Schrödinger equation, (3) aspects of the spectral theorem for bounded and unbounded self-adjoint operators, and (4) the quantum harmonic oscillator. Other possible topics include the angular momentum and spin, the WKB approximation for the one-dimensional Schrödinger equation, the energy levels of the hydrogen atom, and the basics of quantization.

There will be some homework, but not as much as in basic courses. Some prior exposure to measure theory and Hilbert spaces is recommended.