



Konstantin K. Likharev  
**Essential Graduate Physics**  
*Lecture Notes and Problems*

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# Part QM: Quantum Mechanics

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B/W paperback copies of this volume are also available on *Amazon.com*:

<https://www.amazon.com/gp/product/B0D7S1GXDG>

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*Supplemental file* **Exercise Problems with Model Solutions** (311 problems, 552 pp.)  
is available online:

<https://essentialgraduatephysics.org/Files/QM%20exercises.pdf> .

B/W paperback copies of these materials are available on *Amazon.com*:

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*Additional file* **Test Problems with Model Solutions** (68 problems, 61 pp.)  
is available for course instructors from the author upon request – see *Front Matter*.

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## Introductory Remarks

The structure of this course is more or less traditional for graduate physics education, with most attention paid to the non-relativistic quantum mechanics, and only Chapter 9 reviewing the relativistic effects.

As in many (though not all) textbooks on this level, the discussion of Dirac's bra-ket formalism is postponed until after the discussion of numerous quantum-mechanical effects in Chapters 1-3 by using the conceptually simpler wave-mechanics approach. One reason for that decision was the author's serious commitment to the *Occam Razor* principle, in particular to the analysis of each physical effect by using the simplest suitable theoretical tools.

A really distinguishing feature of the course is Chapter 7 on open quantum systems, with a focus on the decoherence ('*dephasing*') and energy dissipation ('*relaxation*') effects. These effects are frequently discussed in statistical physics courses, but their understanding is necessary for any informed discussion of quantum measurements and quantum effects in macroscopic systems, with their substantial coupling to the environment.