Preface to the English Edition

This textbook, the translation of the ninth edition of the German book “Maschinen-dynamik” (published in its first edition in Germany and Austria in 1979), discusses disciplines that in many countries are presented separately in lectures titled “Theory of Mechanisms and Machines” (TMM) and “Vibrations” or “Theory of Vibrations”. The basic idea by my distinguished colleague, Prof. Holzweissig, was to combine these disciplines into the “Dynamics of Machinery”. We worked out this concept together in the first three editions, relying on our experience gained in our collaborations with engineers here in Saxony. Since he became a professor emeritus in 1993, I have constantly updated the book since its 4th edition and have added more exercises and sections.

This textbook is based on the four-semester lecture series on “Engineering Mechanics” and confronts students directly with dynamic problems of their field. Dynamics of machinery is viewed both as a typical field for the mathematical modeling of technological processes and as a branch of mechanical engineering that addresses dynamic problems of power machines (reciprocating engines and turbo-machines), processing machines (printing machines, textile machines, packaging machines), hoists and conveyors, agricultural machines and vehicles, as well as industrial plants.

The book comprises relatively independent chapters that discuss typical issues of the dynamics of machinery from the point of view of mechanical engineers. Chapter 6 gives a general overview of linear oscillators and includes methods discussed in Chaps. 3, 4 and 5. We were fully aware and accepted some overlap and repetitions, making many cross-references among sections. Chapter 7 discusses nonlinear and self-excited oscillators, for which calculations are becoming more and more relevant to practical application. Chapter 8 still does not contain any equations, but the rules compiled there are important for engineering practice. We included a new chapter “on interrelations with system dynamics and mechatronics” to enhance the understanding of these adjacent disciplines. This chapter prepares the readers for a more general approach to solving problems of the dynamics of machinery by including sensors and actuators.
The 60 problems with solutions are meant to help in grasping and consolidating the subjects taught. A new feature of this edition is the enclosed CD-ROM, which does not only contain the student version of the SimulationX® software, but also program parts that were used for solving the examples given in the book so that the readers can work with them themselves.

The book was not only written for students, but also for practicing engineers. The examples from many fields of mechanical engineering and the specification of parameter values, as well as references to guidelines and regulations, underline this. We have considered the way in which engineers think by discussing estimation methods, rough calculations and minimal models, and by explaining many instructive dynamic effects (gyroscopic effect, resonance, absorption, self-synchronization, ... ) that are relevant for the design of machines that operate under a high dynamic load. The fast development of hardware and software entailed that nowadays there is software available for almost every problem in the dynamics of machinery. While computers always provide some numbers and diagrams, the engineer is still responsible for the results. It remains the engineer’s job to provide the respective calculation models, to assess the applicability of a software product, to check the result of a simulation, and to have some idea of the result to be expected before the calculation starts.

Since the current development shows a trend towards refined modeling, we pointed out three aspects: the training of physical understanding, the utilization of modal analysis including sensitivity analysis, and the application of computer-aided methods. We stress the fact that the goal of calculations is not only to arrive at a numerical result, but to achieve a better understanding of the dynamic behavior of real objects and to be able to take design measures that are based in physical theory.

I would like to thank many specialists for their suggestions and tips, in particular my former coworkers at the professorship of Dynamics of Machinery of the Chemnitz University of Technology and my colleagues at ITI GmbH Dresden, in particular Dipl.-Ing. Uwe Schreiber, who helped me work out practical examples. The whole book has been translated by Dr. Wolf Grosskopf (Northridge). I was very pleased that my former student, Prof. Dr.-Ing. Sven Esche (Stevens Institute of Technology), agreed to proof-read the manuscript and to review the terminology. I am in particular grateful for this. I would like to give special praise to the committed work of Dipl.-Ing. Andreas Abel who prepared the final manuscript and thereby took into account all my many extra wishes, so that the manuscript could be submitted to the publisher ready for printing.

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