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Book Reviews

Theory of Machines and Mechanisms by John J. Uicker, Gordon R. Pennock and Joseph E. Shigley, 3rd Edition, Oxford Press, 2003.

REVIEWED BY J. MICHAEL McCARTHY[1]

The scholarship of the late Joseph Shigley continues to influence mechanical design education almost a decade after his death in 1994 through the publication of new editions of his books *Theory of Machines and Mechanisms* (Oxford Press) with Profs. Uicker and Pennock, and his *Mechanical Engineering Design* (McGraw-Hill) with Prof. Mischke. *The Theory of Machines and Mechanisms* traces itself to the integration of Prof. Shigley's *Kinematic Analysis of Mechanisms* and *Dynamic Analysis of Machines* into the single book *Theory of Machines* in 1961. John Uicker worked with Prof. Shigley on the 1995 second edition that included the analysis of spatial mechanisms and robots using vector formulations adapted for numerical computation. For this third edition, Gordon Pennock joins Prof. Uicker to provide an impressive new look to this classic text.

The book is divided into three basic parts: kinematics and mechanisms, the design of mechanisms, and dynamics of machines. In the first part, the focus is on the analysis of mechanical movement, and I like the vector and matrix formulation that includes kinematic coefficients because it provides a convenient transition to the analysis of spatial mechanisms and robots. The graphical and complex vector approaches, which are well adapted to the study of planar mechanisms, are carefully presented as well. The second part is a survey of cams, gearing and linkages, and robot kinematics. The third part presents the force analysis, vibration and balancing of a range of machine systems including engines, flywheels, governors and gyroscopes.

My primary concern with this book is that machine theory of the past necessarily focused on the velocity, acceleration and forces in a device at one particular configuration, while it is the value of these parameters throughout the movement that is of interest. Prof. Uicker's Integrated Mechanisms Program (IMP), which dates back to 1964, was among the first software systems for machine simulation, and Prof. Pennock is a leading researcher in robot and spatial linkage analysis. I hope that their future editions move in the direction of showing students how to analyze and simulate the movement of machine systems using the computers that are available to most all engineers.

In any case, this book provides an excellent presentation of machine theory with a depth and breadth that can find use in courses ranging from an undergraduate survey of machine theory to an advanced undergraduate or even graduate level course on machine kinematics and dynamics. Practicing engineers will find this book to be a valuable reference on the principles of machine theory.

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Design of Machinery by Robert L. Norton, 3rd Edition, McGraw-Hill, 2004.

REVIEWED BY J. MICHAEL McCARTHY

While accepting the 2002 Machine Design Award presented by the Design Engineering Division of ASME, Robert Norton argued passionately for the preservation of a machine theory course as the gateway to a mechanical design curriculum. The days of separate courses on kinematics, dynamics, and the design of machinery, followed by a project course seem long gone for many university programs, and Professor Norton meets this challenge directly with the third edition of his book. From beginning to end he focuses attention on design including many project ideas, as he presents the analysis and synthesis of machine systems constructed from gears, cams and linkages. The result is 850 well-written pages packed with useful examples and illustrations.

The material covered in this book includes the fundamentals of design, the kinematics of mechanisms, as well as force analysis in machines. Graphical techniques for both analysis and synthesis build visualization and insight to the meaning of the algebraic formulations, and the complex vector approach provides a compact notation for the study of planar machines. I like his matrix form of force analysis because it reflects a modern approach to machine analysis.

A candidate design requires analysis to measure performance, but even the simple slider-crank is a nonlinear problem solved by the intersection of a circle with a line. The iterative analysis of these nonlinear problems is a job for computer-based tools. Professor Norton responds by providing a CD with Working Model and by my count about 150 example files, TKSolver with about 30 examples, and some 100 examples of his own programs and handouts. This patchwork of software is a valiant attempt to fill a critical need for software tools for machine theory education. Most engineers use a computer for analysis, drawing, and report generation, so why are computer algebra, drawing and animation not more a part of our machine theory curriculum?

This book is clearly the result of an ongoing commitment to excellence in engineering education. The sequence and scope of the topics and examples are tailored to maintain relevance to students. The content is also broad enough to be shaped to meet the needs of a wide range of introductory courses, which, in some cases, may be the only course on machines. I am pleased to recommend this book to my university colleagues, and to working engineers, who are looking for an excellent introduction to machine theory.