

# Introduction to Dynamics of Rotor-Bearing Systems

This book is written as an introduction to rotor-bearing dynamics for practicing engineers and students who are involved in rotor dynamics and bearing designs. The goal of this book is to provide a step-by-step approach to the understanding of fundamentals of rotor-bearing dynamics. Therefore, the emphasis of this book is on the basic principles, phenomena, modeling, theory, and interpretations of the results. Numerous examples, from a single-degree-of-freedom system to complicated industrial rotating machinery, are employed throughout this book to illustrate these fundamental dynamic behaviors. The concepts in the text are reinforced by parametric studies and numerous illustrative examples and figures.

## INTRODUCTION TO DYNAMICS OF ROTOR-BEARING SYSTEMS

Wen Jeng Chen, Edgar M. Gunter

### Introduction

- Basic Concepts
- Single-Degree-of-Freedom Systems
- Free and Forced Vibrations
- Free Vibration
- Forced Vibration
- Total Motion

### Coordinate Systems and Rotor Motion

- Coordinate Systems
- Steady State Rotor Motion
- Elliptical Motion
- Orbit Simulator

### The Laval-Jeffcott Rotor Model

- The Two-Degrees-of-Freedom Rotor System
- Translational Motion
- Natural Frequencies and Natural Modes
- Steady State Response to Unbalance
- Steady State Response to Shaft Bow
- Internal and External Viscous Dampings
- Rotational Motion and Gyroscopic Effects
- Energy Consideration
- Transient Startup and Shutdown
- The Effects of Flexible Support

### Rotating Disk Equations and Rigid Rotor Dynamics

- Rigid Disk Equations
- Rigid Rotor Dynamics
- Rigid Disk on Flexible Rotor
- Flexible Disk Equation
- Offset Disk Equation

### Shaft Finite Element Equations

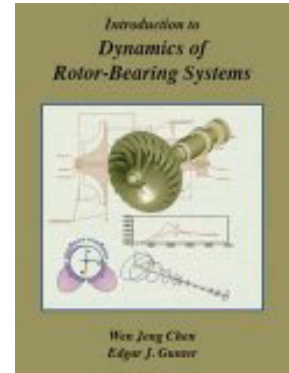
- General Considerations
- Cylindrical Element
- Conical Element
- User's Supplied Element
- Sub-Element Condensation
- Couplings
- Examples

### Bearings and Other Interconnection Components

- General Consideration
- Bearing Coordinate Systems
- Fundamentals of Hydrodynamic Journal Bearings
- Fixed Profile Journal Bearings
- Reynolds Equation
- Bearing Static and Dynamic Characteristics
- Solutions for Reynolds Equation
- Linear and Nonlinear Analyses of a Journal Bearing
- Tilting Pad Journal Bearings
- The Infinitely Short Cylindrical Journal Bearing
- Squeeze Film Dampers
- Floating Ring Bearings
- Gas Lubricated Bearings
- Rolling Element Bearings
- Magnetic Bearings
- Liquid Annular Seals
- Aerodynamics Cross Coupling Force

### System Governing Equations and Analyses

- Governing Equations of Motion
- Static Deflection and Bearing Loads
- Critical Speeds and Modes
- Whirl Speeds and Stability Analysis
- Steady State Synchronous Response



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- Transient Response
- Examples

### Torsional Vibration

- General Introduction
- Element Equation
- Two-Inertia System
- Geared System
- Couplings
- System Equations of Motion
- Natural Frequencies and Modes
- Steady State Forced Response
- Transient Motion
- Examples

### Balancing

- General Introduction
- Influence Coefficient Method
- Examples

### Appendices

- A. Mass Properties
- B. Elemental Matrices
- C. Lubricant Properties
- D. Systems of Units

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