

directors deserve a round of applause for making this symposium an extremely informative event.

Fundamentals of Acoustics. 3rd Ed. by L. E. Kinsler, A. R. Frey, H. B. Coppens, and J. V. Sanders, Wiley, New York, 1982, 480 pages. Price: \$31.95

Reviewed by H. Saunders

Kinsler and Frey have been "household" names in the world of acoustics for the past three decades. Many acousticians and engineers have been weaned and raised on their *Fundamentals of Acoustics*. The third edition rearranges the contents of the previous editions and puts them in the proper place. This new edition updates some features of acoustics and keeps the more fundamental aspects in its proper perspective. Among the newer phases of acoustics (some mentioned in this book) are noise control, boundary layer acoustics, acoustic emission, and ultrasonics. Understanding the fundamentals propounded in this book will furnish a good foundation in the understanding of the more advanced and newer aspects of acoustics.

The book consists of 15 chapters and ten small appendices.

Chapter 1 treats the topic of fundamentals of vibrations. This includes the simple oscillator subjected to forced oscillation, transient response, power relationships, mechanical resonance and frequency. It concludes with equivalent electrical circuit for a simple oscillator, transients and Fourier analysis. There is very little change from the previous edition.

Chapter 2 considers transverse motion of a vibrating string. This includes transverse waves on a string, one-dimensional wave equation, initial value and boundary conditions applied to wave equation. This continues with forced vibration of a finite and infinite string, normal modes and overtones, and harmonics. Again, this chapter is just a slight rearrangement of the information in the same chapter of the previous edition.

Chapter 3 follows the same format of the previous edition and considers vibrations of bars. This encompasses longitudinal vibrations, forced vibration, transverse vibration and transverse wave equation. The clamped and free conditions are applied to the beam equation.

Chapter 4 proceeds into the vibration of membranes and plates. The authors examine the wave equation for stretched, rectangular and circular membranes fixed at the rim. The chapter concludes with forced vibration of a membrane and vibrations of thin circular plates. The reviewer feels that the topic of rectangular plate and its associated boundary conditions should have been included.

Chapter 5 focuses on the acoustic wave equation. Beginning with equation of state and continuity, this leads into Euler's equation, harmonic plane waves, acoustic intensity, specific acoustic impedance and decibel scales. New additions embrace rays and waves, Snell's law, inhomogeneous wave equation and point source. Again, there is very little change from the previous editions.

Chapter 6 examines transmission phenomena. This fundamental chapter treats in a simple manner, transmission from one fluid to another, reflection at the surface of a solid for both normal and oblique incidence.

Probing further, we meet absorption and absorption coefficients, molecular thermal relaxation, absorption-phenomena in liquids and attenuation in inhomogeneous fluids. Again, this is a readable chapter.

Chapter 8 treats the important radiation and reception of acoustic waves. This encompasses radiation from a pulsating source, acoustic reciprocity, dipole radiation, directional factor and beam patterns. Proceeding, we encounter an in-

teresting section on radiation from a plane circular piston and radiation impedance. New additions include directional factors of reversible transducers, simple line array and its associated equation plus a simple array applied to identical sources.

Chapter 9 collects in one location, a number of topics concerning pipes, cavities, and waveguides. This considers resonance in pipes, power radiation from open-ended pipes, standing wave patterns, rectangular cavity and absorption of sound in pipes. The new addition relates to waveguide of constant cross section.

We now enter upon some of the most important aspects of applied acoustics. This chapter includes acoustic filters (low, high and band pass), filter networks and resonant air bubbles in water. The important Helmholtz resonator including the flanged and unflanged conditions are considered. This leads to the resulting differential equation and the frequency equation. The authors discuss in a very lucid manner distributed acoustic impedance and also include the electrical and mechanical analogues. The reviewer believes that the authors should have included the more recent additions and equation corrections to Helmholtz frequency equation. Additional topics should include Helmholtz resonators to noise dissipation and sections on transmission matrices. This is an important aspect of modern acoustic applications.

Chapter 11 examines noise, signal detection, hearing and speech. Although noise is discussed throughout the book, this chapter develops the spectrum and band level, methods of combining band levels and tones plus detection of signal in noise. In most texts the physical properties of the human ear are mentioned but hardly ever explored. This text examines fundamentals, i.e., thresholds, critical bandwidth, equal level contours, masking, and cochlear nonlinear effects. The chapter concludes with an interesting discussion of speech and its physical origination. Although brief, it is a most useful chapter and should be read by all.

Environmental acoustics affects all of us. The effect of noise as experienced by the human being ranges from slight annoyance to anger. Noise affects economic factors by decreasing worker efficiency and consequently worker turnover. Chapter 12 treats the weighted sound levels (A, B & C) and their measure of noise. This leads to speech interference and preferred noise criteria. Community noise is measured in the statistical sense, i.e., average in daytime, evening, night, hourly and day-night sound levels. The authors further consider highway and aircraft noise, and the community response to noise. The chapter concludes with design of single leaf, double leaf, door and window partitions. This is a good chapter, but too brief at times.

Chapter 13 describes an old standby, i.e., architectural acoustics. Most acoustic tests study a portion of this subject. This chapter begins with a single model for growth of sound in a room and continues with reverberation time (Sabine, Norris-Eyring, Mellington-Searle) and sound absorption. The measurement of acoustic output in live rooms is important since it affects every one of us. The authors continue with acoustic factors in architectural design, i.e., direct arrival of sound, reverberation at 560 Hz, warmth and intimacy. The chapter concludes with a pleasant discussion of standing waves and normal modes in enclosures. This includes damped normal modes, driven standing wave, growth and decay of sound from a source and reverberation of normal modes. This is a good chapter. Except for normal enclosure, it is a mirror image of previous editions.

Chapter 14, the lengthiest, focuses upon the transducer as a vital part of noise measurements and transmitters of sound. Beginning with transducers as an electrical network, we continue with canonical equations for two simple transducers, transmitters (reciprocal and antireciprocal), moving coil loudspeaker, receivers (microphone sensitivities and direc-

tivities and loudspeaker cabinets). The chapter ends with an interesting discussion of microphones (condensor, moving coil, pressure gradient and piezoelectric). This chapter is a combination of a number of sections in the previous editions and thus permits easier reading.

The last chapter considers underwater acoustics. The authors have completely revised the contents and specifically point out the various aspects comprising underwater acoustics. Beginning with speed of sound and sound transmission loss in water, we proceed to sonar equations, noise and bandwidth considerations, passive and active sonar and isospeed shallow-water channel. The closing section of the book report on solutions of point source in cylindrical coordinates, isospeed channel with rigid and fluid bottoms.

In summary, this book has lost none of its popular flavor. It still carries the "banner on high." The reviewer would have preferred seeing additional sections on ultrasonics and acoustic emissions. Other topics, which should have been included are transmission from one pipe to another, spherical acoustic waves and barrier design. The reviewer further believes that data processing, which is so important in acoustics, should have been included. Consequently, computer programs used in data processing and problem solution are a must. Nevertheless, the reviewer recommends this book to the tyro as well as the experienced. Future acousticians will be weaned on this book in a similar manner that we previously underwent the growing process. Bravo to the authors for a well written book!