## CONTENTS

		Page			
FC	OREWORD NDEX OF SYMBOLS ABBREVIATIONS OF JOURNALS				
AE	BREVIATIONS OF JOURNALS	xxiii			
1.	DEVELOPMENT AND METHODS OF ACOUSTIVAL ENGINEERING				
	1. The science of sounds	1			
	2. The range and division of modern acoustics	3			
	3. Methods of acoustical engineering	8			
	4. System of symbols and units	10			
	Suggested readings and books of historical value	12			
2.	ACOUSTIC WAVE PROPAGATION IN EXTENDED FLUID MEDIA WITH				
	NEGLIGIBLE DISSIPATIONS	1.4			
	1. Introduction	14			
	2. Wave motion in fluid media Characteristic wave equations	15 18			
	<ol> <li>Characteristic wave equations</li> <li>Acoustic potential and general wave equations</li> </ol>	26			
	<ol> <li>Acoustic potential and general wave equations</li> <li>Analysis of time change and space distribution</li> </ol>	20			
	<ol> <li>6. Energy of the acoustic wave</li> </ol>	40			
	7. Gravity waves	49			
	8. Numerical determination of the characteristic quantities of the field	51			
	Problems	54			
	Suggested readings	58			
3.	ACOUSTIC WAVE PROPAGATION IN LOSSLESS SOLIDS				
	1. Introduction	59			
	2. Strains of the medium and the strain tensor	61			
	3. Stresses in the medium and the stress tensor	69			
	4. General stress-strain relations	72			
	5. Equations of motion in solids	77			
	6. Energy of acoustic waves	83			
	7. Rayleigh waves	85			
	Problems Suggested readings	89 95			
	Suggested readings	93			
4.	SINGLE REFLECTION OF ACOUSTIC WAVES				
	1. Introduction	97			
	2. Reflection of a plane sound wave form a plane boundary of fluid media	99			
	3. The acoustic field in the medium I	108 113			
	<ul><li>4. Reflection in a fluid medium from a boundary with a complex input impedance</li><li>5. Reflection of a plane acoustic wave from a plane boundary between two</li></ul>	115			
	solid media	117			
	6. Reflection of a wave beam in fluids	126			
	<ol> <li>Reflection of a spherical wave</li> </ol>	120			
	8. Reflection from a corrugated surface	138			
	Problems	141			
	Suggested readings	146			
5.	SURFACE SOURCES OF ACOUSTIC WAVES				
	1. Introduction	149			
	2. General method for determining the source radiation	150			
	3. Simplified general formulas for the source radiation	154			

	<ul> <li>4. The field characteristic of the source</li> <li>5. Characteristic of the source as a vibrating system</li> <li>6. Radiation of spherical sources</li> <li>7. The field characteristic of a circular membrane</li> <li>8. The characteristic of a circular membrane as a vibrating system</li> <li>9. The radiation of other types of piston membranes</li> <li>10. The radiation of a group of sources</li> <li>11. The source of perturbation in a solid medium</li> <li>12. Radiation transients of sources</li> <li>Problems</li> </ul>	162 167 173 177 187 193 198 201 204 206
	Suggested readings	210
6.	<b>PERTURBATION OF THE ACOUSTIC FIELD DUE TO AN OBSTACLE</b> 1. Introduction	212
	<ol> <li>General method of solving the problem</li> </ol>	212
	3. Immobile, rigid obstacle in a fluid medium	219
	4. Effect of the motions of the obstacle on the perturbation field	231
	5. The field of a perfectly reflecting disc	233
	6. Elastic obstacle in a fluid medium	237
	7. Obstacle in a solid body Problems	240 246
	Suggested readings	253
-		
7.	WAVE PROPAGATION IN REAL LIQUIDS AND GASES 1. Introduction	255
	<ol> <li>Wave attenuation in ideal gas due to internal friction</li> </ol>	258
	3. Wave attenuation caused by heat losses in ideal gas	263
	4. Macroscopic representation of molecular absorption	267
	5. Molecular mechanism of wave propagation in gases	278
	6. The molecular mechanism of wave propagation in liquids	286
	<ol> <li>The functional dependence of wave velocity on temperature</li> <li>Attenuation as a function of the temperature</li> </ol>	291 296
	<ol> <li>Attenuation as a function of the temperature</li> <li>Acoustical properties of substances near the critical and freezing temperatures</li> </ol>	296 299
	10. Acoustic properties of homogeneous mixtures	303
	11. Acoustic properties of air and water	306
	Problems	314
	Suggested readings	316
8.	WAVE PROPAGATION IN REAL SOLID MEDIA	
	1. Introduction	323
	2. Attenuation due to viscosity and heat dissipation	327
	3. Attenuation connected with anelastic properties of a material	331
	<ol> <li>General representation of losses in a homogeneous medium</li> <li>Wave propagation in polycrystalline structure materials</li> </ol>	338 342
	<ol> <li>6. The influence of magnetic and electric properties of materials on</li> </ol>	542
	wave propagation	351
	7. Wave propagation in crystals	355
	8. Acoustic wave attenuation connected with dislocations	358
	9. The influence of the presence of free atoms and electrons on wave attenuation in	
	crystals	364
	Problems Suggested readings	368 370
		570
9.	SYSTEMS WITH LUMPED CONSTANTS 1. Introduction	275
	<ol> <li>Introduction</li> <li>Free vibrations of a resonant mechanical system</li> </ol>	375 378
	<ol> <li>Other mechanical systems with one degree of freedom</li> </ol>	381
	<ol> <li>Forced vibrations of a system with on degree of freedom</li> </ol>	387
	5. Vibrating system in a transient state	389
	6. The Helmholtz resonator as an elementary acoustical system	393

	<ol> <li>Acoustical behaviour of the resonator</li> <li>Analogies between mechanical and electrical systems</li> <li>Systems with several degrees of freedom</li> <li>Problems</li> <li>Suggested readings</li> </ol>	397 402 407 413 422
10.	<ol> <li>ONE-DIMENSIONAL SYSTEMS WITH DISTRIBUTED CONSTNATS</li> <li>Introduction</li> <li>Uniform systems of infinite length excited longitudinally</li> <li>Exact calculations of longitudinal vibrations of a bar</li> <li>Uniform bar or duct with losses</li> <li>Uniform systems of infinite length excited transversally (strings)</li> <li>Uniform systems of infinite length excited transversally (bars)</li> <li>Vibrations of uniform systems with a finite length (pipes)</li> <li>Vibrations of uniform systems with finite length (strings and bars)</li> <li>Systems of infinite length with a variable cross-section (sudden change of the cross-section)</li> <li>Systems of infinite length with a variable cross-section (horns)</li> <li>Properties of horns with a finite length</li> <li>Horn with a finite length as a four-pole</li> <li>Phase velocity and group velocity in acoustic systems</li> <li>Suggested readings</li> </ol>	425 427 430 435 442 444 450 453 457 461 469 472 477 482 488
11.	<ol> <li>TWO-DIMENSIONAL SYSTEMS</li> <li>Introduction</li> <li>Acoustic field in a fluid layer of infinite extent</li> <li>Vibrations of a membrane of infinite extent</li> <li>Longitudinal vibrations of a plate of infinite extent</li> <li>Transverse vibrations of a plate of infinite extent</li> <li>Free vibrations of bounded membranes</li> <li>Free vibrations of a circular plate</li> <li>Free vibrations of a circular plate</li> <li>Forced vibrations of bounded membranes and plates</li> <li>Membranes and plates in an acoustic field</li> <li>The action of an acoustic wave with oblique incidence on a plate</li> <li>Vibrations of a plate with a compliance load</li> <li>Problems</li> <li>Suggested readings</li> </ol>	490 492 499 501 505 509 516 521 522 529 534 537 539 544
12.	<ol> <li>BOUNDED SPATIAL SYSTEMS</li> <li>Introduction</li> <li>The geometrical method of investigating spatial systems</li> <li>Resonance frequencies of a right parallelepiped</li> <li>Distribution of the acoustic field in a right parallelepiped</li> <li>Dependence of wave attenuation on the impedance of the boundary surface</li> <li>Steady-state in an arbitrary enclosure</li> <li>Absorption of energy by the boundaries of an enclosure</li> <li>A right parallelepiped enclosure in a transient state</li> <li>Sound field in an arbitrary space system</li> <li>Parameters of the space system</li> <li>Solid body as a spatial vibrating system</li> <li>Problems</li> <li>Suggested readings</li> </ol>	546 548 551 558 563 569 574 579 584 590 595 599 603
13.	<ol> <li>EXTENDED SPATIAL SYSTEMS</li> <li>Introduction</li> <li>General wave equations for an inhomogeneous medium</li> <li>Determination of the path of a sound ray</li> <li>Acoustical properties of a mobile medium</li> </ol>	607 610 613 625

	5.	A medium with randomly distributed inhomogeneities	631		
	6.	Reverberation in extended systems	637		
	7.	Media with distinct macroscopic inhomogeneities	645		
	8.	Electro-acoustical analogies in spatial space systems	649		
	Pro	blems	652		
	Sug	gested readings	655		
14.	FIN	NITE-AMPLITUDE WAVES AND VIBRATIONS			
	1.	Introduction	658		
	2.	Equations of motion of a finite-amplitude plane wave in a fluid, lossless medium	n 661		
	3.	Changes of the wave profile in a lossless fluid medium	668		
	4.	Energy of a finite-amplitude wave	673		
	5.	Occurrence of discontinuities in a finite-amplitude wave	677		
	6.	Mechanism of the propagation of a discontinuity	682		
	7.	The influence of the absorption of the medium on the propagation of			
		finite-amplitude waves	688		
	8.	Reflection of a finite-amplitude wave	693		
	9.	A finite-amplitude wave in a solid homogeneous medium	694		
		The influence of the physical nonlinearity of solid media on wave propagation	698		
		Properties of nonloinear systems with lumped constants	704		
		Free vibrations of nonlinear systems	711		
	13.	Forced and damped vibrations of nonlinear systems	714		
	Pro	blems	720		
	Sug	ggested readings	724		
NA	NAME INDEX				
SU	SUBJECT INDEX				