Contents

		Page
Preface to the first edition		xi
Preface to the second edition		xv
Notes for reference		xvi
1	**Free vibrations**	1
1.1	Harmonic motion	2
1.2	Alternative mathematics for harmonic motion	10
	Problems	14
2	**Free vibrations in physics**	15
2.1	Angular vibrations	15
2.2	Acoustic vibrations	18
2.3	Plasma vibrations	21
2.4	Molecular vibrations	24
2.5	Circuit oscillations	29
	Problems	32
3	**Damping**	34
3.1	Light damping	35
3.2	Heavy damping	39
3.3	Critical damping	41
	Problems	43
4	**Damping in physics**	44
4.1	Resistance damping	44
4.2	Electromagnetic damping	45
4.3	Collision damping	49
4.4	Friction damping	52
	Problems	54

5 Forced vibrations 55
5.1 Steady states 56
5.2 Superposition 68
5.3 Transients 73
Problems 75

6 Forced vibrations in physics 78
6.1 Resonant circuits 78
6.2 Scattering of light 81
6.3 Dielectric susceptibility 84
6.4 Absorption of microwaves by water 86
Problems 92

7 Anharmonic vibrations 93
7.1 A symmetric return force 93
7.2 An asymmetric return force 99
7.3 Forced vibrations of non-linear systems 104
Problems 107

8 Two-coordinate vibrations 110
8.1 Modes and mode coordinates 110
8.2 Forced vibrations 121
8.3 How to find the mode coordinates 126
8.4 Coupled circuits 133
Problems 136

9 Non-dispersive waves 139
9.1 Travelling waves 141
9.2 Reflection of travelling waves 146
9.3 Standing waves 154
9.4 Energy propagation 159
9.5 Attenuation 163
Problems 168

10 Non-dispersive waves in physics 171
10.1 Longitudinal waves 171
10.2 Acoustic waves 174
10.3 Cable waves 180
Problems 188

11 Fourier theory 189
11.1 Harmonic analysis 189
11.2 Modulation 199
11.3 Pulses and wave groups 202
Problems 208

12 Dispersion 210
12.1 Stiff strings 210
12.2 Lumpy strings 218
12.3 Evanescent waves 224
Problems 231

13 Water waves 233
13.1 The nature of the wave motion 233
13.2 The dispersion relation 246
13.3 Examples of water waves 249
Problems 253

14 Electromagnetic waves 255
14.1 Electromagnetic waves in a vacuum 256
14.2 Electromagnetic waves in a dielectric 262
14.3 Electromagnetic waves in a plasma 267
Problems 273

15 De Broglie waves 275
15.1 Wave functions 276
15.2 Physical implications 279
Problems 283

16 Solitary waves 284
16.1 Non-linear wave systems 284
16.2 Non-linear dispersion 290
Problems 294

17 Plane waves at boundaries 296
17.1 Reflection and refraction 296
17.2 Standing waves in an enclosure 305
Problems 315

18 Diffraction 317
18.1 Features due to the arrangement of the diffraction centres 318
18.2 Features due to the nature of the diffraction centres 327
Problems 336

Answers to problems, and hints for solution 340
Constants and units 348
Index 349