Contents

	Preface	*ix*
1	**Motion and forces at a point of contact**	1
1.1	Frame of reference	1
1.2	Relative motion of the surfaces – sliding, rolling and spin	3
1.3	Forces transmitted at a point of contact	4
1.4	Surface tractions	5
1.5	Examples (1) involute spur gears	6
	(2) angular contact ball bearings	8
2	**Line loading of an elastic half-space**	11
2.1	The elastic half-space	11
2.2	Concentrated normal force	14
2.3	Concentrated tangential force	17
2.4	Distributed normal and tangential tractions	18
2.5	Uniform distributions of traction	21
2.6	Triangular distributions of traction	26
2.7	Displacements specified in the loaded region	28
2.8	Indentation by a rigid flat punch	35
2.9	Traction parallel to the y-axis	42
3	**Point loading of an elastic half-space**	45
3.1	Potential functions of Boussinesq and Cerruti	45
3.2	Concentrated normal force	50
3.3	Pressure applied to a polygonal region	53
3.4	Pressure applied to a circular region	56
3.5	Pressure applied to an elliptical region	63
3.6	Concentrated tangential force	68
3.7	Uni-directional tangential tractions on elliptical and circular regions	70
3.8	Axi-symmetrical tractions	76
3.9	Torsional loading	80

4	**Normal contact of elastic solids – Hertz theory**	84
4.1	Geometry of smooth, non-conforming surfaces in contact	84
4.2	Hertz theory of elastic contact	90
4.3	Elastic foundation model	104
5	**Non-Hertzian normal contact of elastic bodies**	107
5.1	Stress conditions at the edge of contact	107
5.2	Blunt wedges and cones	111
5.3	Conforming surfaces	114
5.4	Influence of interfacial friction	119
5.5	Adhesion between elastic bodies	125
5.6	Contact of cylindrical bodies	129
5.7	Anisotropic and inhomogeneous materials	134
5.8	Layered solids, plates and shells	136
5.9	Numerical methods	144
6	**Normal contact of inelastic solids**	153
6.1	Onset of plastic yield	153
6.2	Contact of rigid-perfectly-plastic solids	157
6.3	Elastic-plastic indentation	171
6.4	Unloading of a plastic indentation, cyclic loading and residual stresses	179
6.5	Linear viscoelastic materials	184
6.6	Nonlinear elasticity and creep	196
7	**Tangential loading and sliding contact**	202
7.1	Sliding of non-conforming elastic bodies	202
7.2	Incipient sliding of elastic bodies	210
7.3	Simultaneous variation of normal and tangential forces	220
7.4	Oscillating forces	224
7.5	Torsion of elastic spheres in contact	231
7.6	Sliding of rigid-perfectly-plastic bodies	233
8	**Rolling contact of elastic bodies**	242
8.1	Micro-slip and creep	242
8.2	Freely rolling bodies having dissimilar elastic properties	246
8.3	Tractive rolling of elastic cylinders	252
8.4	Rolling with traction and spin of three-dimensional bodies	256
8.5	A ball rolling in a conforming groove	268
8.6	Transient behaviour in rolling	271
8.7	Elastic foundation model of rolling contact	275
8.8	Pneumatic tyres	277

9	**Rolling contact of inelastic bodies**	284
9.1	Elastic hysteresis	284
9.2	Elastic-plastic materials: shakedown	286
9.3	Rolling of a rigid cylinder on a perfectly plastic half-space	295
9.4	Rolling contact of viscoelastic bodies	302
9.5	Rolling friction	306
10	**Calendering and lubrication**	312
10.1	An elastic strip between rollers	312
10.2	Onset of plastic flow in a thin strip	318
10.3	Plastic rolling of strip	320
10.4	Lubrication of rollers	328
11	**Dynamic effects and impact**	340
11.1	Stress waves in solids	340
11.2	Dynamic loading of an elastic half-space	343
11.3	Contact resonance	349
11.4	Elastic impact	351
11.5	Inelastic impact	361
11.6	Travelling loads – high speed sliding and rolling	369
12	**Thermoelastic contact**	374
12.1	Introduction	374
12.2	Temperature distributions in a conducting half-space	375
12.3	Steady thermoelastic distortion of a half-space	380
12.4	Contact between bodies at different temperatures	384
12.5	Frictional heating and thermoelastic instability	391
13	**Rough surfaces**	397
13.1	Real and apparent contact	397
13.2	Contact of regular wavy surfaces	398
13.3	Characteristics of random rough surfaces	406
13.4	Contact of nominally flat rough surfaces	411
13.5	Elastic contact of rough curved surfaces	416
	Appendices	
1	Cauchy Principal Values of some useful integrals	424
2	Geometry of smooth non-conforming surfaces in contact	425
3	Summary of Hertz elastic contact stress formulae	427
4	Subsurface stresses in line contact	429
5	Linear creep coefficients	431
	References and author index	432
	Subject index	448