

Contents

Acknowledgments.....	vi
Preface.....	vii
1 Introduction.....	1
Foundation of Physical Theories.....	1
Atomistic Modeling and Computation.....	2
PDE-Based Continuum Modeling and Computation.....	4
2 Fundamental of Continuum Mechanics.....	6
Kinematics.....	6
Basic Laws of Motion.....	11
Constitutive Theory.....	16
Thermoviscoelastic Solid and Its Special Cases.....	20
Problems.....	24
3 Fundamentals of Finite Element Method.....	31
Integral Formulation of Continuum Problems.....	31
Weighted Residual Methods.....	33
Variational Principle.....	37
Introduction to Finite Element Method.....	42
Shape Functions in Finite Element Method.....	42
Finite Element Formulation.....	47
Numerical Integration in Finite Element Method.....	48
Problems.....	52
4 An Overview on Meshless Methods and Their Applications.....	55
Approximation Function.....	55
Numerical Implementation.....	60

Applications.....	63
Problems.....	67
5 Procedures of Meshless Methods.....	68
Construction of the Approximation.....	68
Choice of Weight Function.....	70
Formulation of Meshless Analysis.....	72
Evaluation of the Integral.....	74
Treatment of Discontinuity.....	76
Treatment of Mirror Symmetry.....	77
H- and P-Refinements.....	78
Problems.....	81
6 Meshless Analysis of Elastic Problems.....	83
Background Theory for Applications of Elastostatics.....	83
Meshless Analysis of Elastostatic Problems.....	88
General Dynamic Problems.....	95
Meshless Analysis of Elastodynamic Problems.....	101
Meshless Analysis of Multiphase Materials.....	105
Problems.....	110
7 Meshless Analysis of Nonlocal Continua.....	113
Introduction to Nonlocal Theory.....	113
The Framework of Nonlocal Theory.....	114
Material Instability and Intrinsic Length.....	116
Nonlocal Constitutive Relations.....	116
Formulation of Nonlocal Meshless Method.....	117
Numerical Examples by Nonlocal Meshless Method.....	119
Discussions.....	122
Problems.....	124
8 Meshless Analysis of Plasticity.....	125
Constitutive Relations.....	125
Return Mapping Algorithm.....	129
J_2 Flow Theory.....	131
Meshless Analysis of High-Speed Impact/Contact Problem.....	134
Incremental Plasticity and Slow Crack Growth Problem.....	143
Remarks.....	151
Problems.....	151
Appendix A Vectors and Tensors.....	153
Appendix B Representations of Isotropic Scalar, Vector, and Tensor Functions (Wang, 1970, 1971).....	162

Appendix C Classification of Partial Differential Equations 165

**Appendix D User’s Manual: Meshless Computer Program for
Electrostatics and Electrodynamics 172**

**Appendix E User’s Manual: Meshless Computer Program for
Analysis of Crack Growth in Elastoplastic Continuum .. 179**

Bibliography..... 186

Index 196