

# Contents

## **1 Weighted Residual and Variational Methods 1**

- 1.1 Basic definitions
- 1.2 Weighted residual methods
- 1.3 Weak formulations
- 1.4 Initial value problems
- \*1.5 The case of quadratic functionals
- \*1.6 Rayleigh–Ritz method
- \*1.7 Subsidiary conditions

## **2 The Finite Element Technique 57**

- 2.1 Localised functions
- 2.2 The finite element technique
- 2.3 Element matrices
- 2.4 System equations
- 2.5 Solution of the system
- 2.6 The general program

## **3 Interpolation Functions 100**

- 3.1 Introduction
- 3.2 First-order continuity functions for triangular elements
- 3.3 First-order continuity functions for rectangular elements
- \*3.4 Isoparametric elements
- \*3.5 Second-order continuity functions for rectangular elements
- \*3.6 Second-order continuity functions for triangular elements

## CONTENTS

<b>4 Basic Principles and Governing Equations of Fluid Mechanics</b>	<b>145</b>
4.1 Eulerian and Lagrangian formulations: material derivative	
4.2 Deformation rate measures	
4.3 Equilibrium equations	
4.4 The energy equation	
4.5 Constitutive equations—Newtonian fluid	
4.6 Navier–Stokes equations—incompressible Newtonian fluid	
4.7 The principle of virtual power	
4.8 Turbulence	
<b>5 Inviscid Fluids</b>	<b>174</b>
5.1 Basic principles	
5.2 Bernoulli's principle	
5.3 The wave equation	
5.4 Harmonic response of coastal waters	
5.5 Stream function formulation	
*5.6 Cylindrical coordinates	
<b>6 Flow Through Porous Media</b>	<b>207</b>
6.1 Principles of groundwater flow	
6.2 Confined seepage problems	
6.3 Problems involving free surfaces	
*6.4 Transient free surface flow	
*6.5 Confined aquifer analysis	
*6.6 Unconfined aquifer analysis	
<b>7 Shallow Water Circulation Problems</b>	<b>233</b>
7.1 Shallow water equations	
7.2 Finite element formulation	
7.3 Numerical integration schemes	
7.4 Lake circulation	
<b>8 Dispersion Problems</b>	<b>258</b>
8.1 Introduction	
8.2 The mass transfer equation	

## CONTENTS

8.3 Diffusion problems	
8.4 Diffusion and convection problems	
*8.5 Nonlinear diffusion	
<b>9 Viscous Incompressible Flow Problems</b>	<b>281</b>
*9.1 Introduction	
*9.2 Basic principles	
*9.3 Stream function—vorticity approach	
*9.4 Pressure and velocities approach	
*9.5 Free surface flow	
<b>Appendix Numerical integration formulae</b>	<b>304</b>
<b>Index</b>	<b>308</b>

\*Topics which may be omitted in an introductory course without affecting continuity.