

CONTENTS

Preface	ix
1 Governing equations of combustion	
1 Approach	1
2 Continuum theory of a mixture of reacting species	2
3 The Arrhenius factor	5
4 Differential mass diffusion; equality of c_{pi} and of m_i	7
5 The combustion and constant-density approximations	11
6 Constant properties: nondimensionalization	13
7 Equidiffusion: Shvab–Zeldovich variables	15
8 Activation-energy asymptotics	17
2 The premixed plane flame	
1 Models of mixtures	20
2 Cold-boundary difficulty	21
3 Anchored flames	23
4 Asymptotic analysis	25
5 Flat burners	28
6 Near-surface, surface, and remote flames	31
7 Reactions of arbitrary order	33
8 The two-reactant model	34
3 Perturbations: SVFs and NEFs	
1 Prologue	38
2 Modifications of the plane premixed flame for $\mathcal{L} \neq 1$	39
3 Theory of perturbations	41
4 Steady heat loss: the excess-enthalpy flame	43
5 SVFs	47
6 Nonuniform ducts	50
7 An elementary flame holder	51
8 NEFs	53

4 Steady burning of a linear condensate	
1 Responses	58
2 Experimental results; extinction	60
3 Solid pyrolysis under adiabatic conditions	61
4 Radiation from the surface	64
5 Background radiation	67
6 True nature of effective extinction	71
7 Liquid evaporation under adiabatic conditions	73
8 Radiative exchange at the surface; distributed heat exchange	76
5 Unsteady burning of a linear condensate	
1 The problem	79
2 Solid pyrolysis	80
3 Liquid evaporation	86
4 Response to an impinging acoustic wave	87
5 Amplification	90
6 Stability of anchored flames	92
6 Spherical diffusion flames	
1 Diffusion flames	95
2 Steady combustion for $\mathcal{X} = \mathcal{L} = 1$; D -asymptotics	98
3 The nearly adiabatic flame for $\mathcal{X}, \mathcal{L} \neq 1$ and its stability	103
4 General ignition and extinction analyses for $\mathcal{X} = \mathcal{L} = 1$	108
5 Remarks on the middle branch of the S-response	112
6 Other responses	113
7 The burning fuel drop	115
8 Further results on stability	117
7 Cylindrical and spherical premixed flames	
1 Cylindrical flames	120
2 Planar character	120
3 Near-surface, surface, and remote flames	123
4 Spherical flames; D -asymptotics	124
5 Ignition and extinction	127
6 Other aspects of responses	130
8 Multidimensional theory of premixed flames	
1 The flame as a hydrodynamic discontinuity	136
2 Slow variation and near-equidiffusion	139
3 The basic equation for SVFs	142
4 Flame stretch	146
5 The basic equations for NEFs	149
6 Reduction to Stefan problems	151
9 Burners	
1 Features of a tube flame	154
2 Hydrodynamic considerations	156

<i>Contents</i>	vii
3 SVF tips	159
4 NEF tips	163
5 Quenching by a cold surface	168
6 Further hydrodynamic considerations	170
10 Effects of shear and strain	
1 Nonuniformities	175
2 Response of NEFs to simple shear	176
3 Response of NEFs to simple strain	179
4 More general nonuniformity	185
5 Effect of slowly varying shear	187
6 Effect of slowly varying strain	189
11 Stability	
1 Scope	193
2 Slowly varying perturbations of the plane wave	196
3 Buoyancy and curvature	199
4 Stability of plane NEFs	202
5 Cellular flames	206
6 Hydrodynamic effects	209
7 Curved cellular flames	214
8 Delta-function models and the right stability boundary	218
12 Ignition and explosion	
1 Synopsis	221
2 Spontaneous combustion (auto-ignition)	222
3 Adiabatic explosion	227
4 Explosion with heat loss	232
5 Ignition by heat flux	238
6 Auto-ignition and explosion of separated reactants	241
<i>Text references</i>	248
<i>Further references</i>	256
<i>Citation Index</i>	261
<i>Subject Index</i>	263