

Contents

Preface		page XI
1	Environmental systems of rock, soil and earth energy exchanges	1
1.1	The planet earth	1
1.2	The rock cycle	2
1.3	Soils, the interface of earth environments	5
1.4	Processes of soil formation	8
1.5	Energy- and water-exchange systems at the	·
	earth/atmosphere interface	18
1.6	How things are measured – units and	, ,
	conversions	29
Main	symbols for Chapter 1	42
Exerc	,	42
Refer	References and bibliography	
2	Soil and soil strength	46
2.1	Introduction	46
2.2	Introductory mechanics	48
2.3	Physical characteristics of soil	51
2.4	Strength and behaviour of	3,
	sediments	59
2.5	Stress, strength and strain	63
2.6	Soil strength	67
2.7	Effects of water content on soil	
	strength	72
2.8	The consistency of soil	76
2.9	Some environmental implications of the	
	mechanical characteristics of soil	79
Main symbols for Chapter 2		80
Exercises		80
References and bibliography		83

3	The behaviour of liquids	8-
3.1	Introduction	8-
3.2	The environmental significance of liquids	8.
3.3	Fluid pressure and buoyancy	8
3.4	Liquids in motion	9
3.5	Energy and fluid flow	9
3.6	Flow around submerged solids	10
3.7	Oceans and waves	110
3.8	An introduction to ocean-wave-coastline	
	interactions	110
Mair	n symbols for Chapter 3	120
Exer		12
Refe	rences and bibliography	124
4	Soil, water and watersheds	12:
4.1	Introduction	12:
4.2	Precipitation and runoff measurement	131
4.3	Soil water content and its profile storage	13.
4.4	The water budget for a watershed using the	
	principle of mass conservation of water	137
4.5	Water-balance accounting	14
Main	symbols for Chapter 4	149
Exercises		149
Refer	rences and bibliography	152
5	Evapotranspiration and exchange of energy	
	at the earth's surface	153
5.1	An introduction to vegetation-based ecosystems	153
5.2	Atmospheric humidity	157
5.3	Evaporation from an open-water surface	161
5.4	Measurement of evapotranspiration using the	
	principle of conservation of energy	162
5.5	Determination of evapotranspiration from	
	vegetated surfaces using standard	
	meteorological data	175
5.6	Non-radiative sensible heat exchange between	
	the land surface and the lower atmosphere	182
5.7	Ground heat flux and soil temperature	185
Main symbols for Chapter 5		
Exerc		191
References and bibliography		195

286

287

Exercises

References and bibliography

9	Watersheds and rivers	289
9.1	Introduction	290
9.2	Hydrological considerations at watershed and	
	catchment scale	292
9.3	Sediment transport in watersheds	300
9.4	The transport of nutrients and other chemicals	
	in watersheds	307
9.5	Rivers	311
9.6	River health	316
Main symbols for Chapter 9		320
Exerci	Exercises	
Refere	ences and bibliography	322
10	Movement of water through the	
	groundwater zone	324
10.1	Introduction	324
10.2	Groundwater at equilibrium	327
	Movement of groundwater	330
10.4		340
Main	symbols for Chapter 10	342
Exerci	ses	343
Refere	ences and bibliography	348
11	Movement of water through the	
	unsaturated zone	350
11.1	Introduction	350
11.2		
	unsaturated zone	352
11.3	Water and solids in equilibrium	356
11.4	Movement of water in the unsaturated zone	364
Main	symbols for Chapter 11	376
Exerci		3 <i>77</i>
Refere	ences and bibliography	378
12	Salinity and contaminant transport	380
12.1	Introduction	381
12.2	Dryland salinity processes	383
12.3	Irrigation-induced salinity processes	388
12.4	Movement of contaminants in groundwater	391
12.5	Contaminant transport in the unsaturated zone	397

12.6	Solute and contaminant transport in	
	agricultural contexts	404
Main symbols for Chapter 12		414
Exercises		415
References and bibliography		417
Appendix		419
Answers to all exercises		421
Index		434