CONTENTS

Preface	xi
Chapter 1 – Introduction	
Historical Notes	
Limits on Windmill Power	1
Concluding Remarks	2
References	5
Chapter 2-Extraction of Energy From the Wind	7
Applications of Wind Power	7
Electrical Energy	7
Chemical Energy	8
Thermal Energy	8
Potential Energy	9
Pumping and Irrigation	11
Heating	11
Concluding Remarks	11
Siting and Wind Characteristics	11
Environmental Considerations	13
Flows Over Hills	13
Types of Wind Turbines	16
Ideal Windmill Performance	21
References	I
Chapter 3 – Energy in the Wind	27
Geographical Wind Distributions	27
Local Wind Distributions	27
Vertical Wind Speed Gradient	20
Annual Energy Capture	4 <i>7</i> 22
References	33
	30

Chapter 4 – Propeller Turbines	37
Performance of Blade Elements	40
Optimum Performance of Propeller Turbines	·40
Forces and Moments on Blades	50
Aerodynamic Performance of Blades	53
Off-Design Performance	56
Augmented Wind Turbines	57
Approximate Relations	66
Concluding Remarks	68
References	69
Chapter 5–Vertical Axis Lifting Surface Turbines	
References	78
Chapter 6 – Drag-Type Turbines	79
Paddle Turbines	79
Savonius Rotors	85
A Simple Savonius Rotor Flow Analysis	89
References	98
Chapter 7-Extraction of Energy From the Wind	99
Propeller Turbines	102
Savonius Rotors	106
Annual Energy Acquisition	106
References	108
Chapter 8 – Cost of Wind Power .	109
Utilization of Wind Energy .	109
Components and Systems	110
Cost Estimating Relations	112
Costs of Commercial Systems	113
Cost of Energy	113
References	117
Chapter 9-Preliminary Design Procedures	119
References	123
List of Symbols	125
Index	129