Table of Contents

Preface \mathbf{xi} Chapter 1 / Vector Analysis 1 1.1. Definitions and Notation 1 2 1.2. Vector Algebra 1.3. Gradient $\mathbf{5}$ 1.4. Divergence, Curl and Laplacian $\mathbf{7}$ 1.5. Integral Calculus 9 1.6. The Dirac Delta Function 121.7. Cylindrical and Spherical Coordinates 13 Chapter 2 / Review of Classical Electromagnetism 172.1. Introduction 17 2.2. Equations of Motion 202.3. Electric and Magnetic Forces 262.4. Lorentz's Force Law 36 2.5. Maxwell's Equations 38 2.6. Derivation of Gauss's Law 45

	Table	of	Contents
--	-------	----	----------

Cha	apter 3 / Weber's Electrodynamics	47
3.1.	Wilhelm Weber and His Electromagnetic Researches	47
3.2.	Weber's Force	56
3.3.	Weber's Potential Energy	61
3.4.	Conservation of Linear Momentum, of Angular Momentum and of Energy	63
3.5.	Lagrangian and Hamiltonian Formulations of Weber's Electrodynamics	68
3.6.	Maxwell and the Electrodynamics of Weber	73
Cha	apter 4 / Forces of Ampère and Grassmann Between Current Elements	78
4.1.	Ampère's Force Between Current Elements	78
4.2.	Derivation of Ampère's Force from Weber's Force	84
4.3.	Grassmann's Force and Biot-Savart's Law	89
4.4.	Derivation of Grassmann's Force from Lorentz's Force	91
4.5.	Ampère Versus Grassmann	92
4.6.	Force Between Circuits from the Coefficient of Mutual Inductance	98
4.7.	Derivation of the Magnetic Circuital Law and of the Law of Nonexistence of	
	Magnetic Monopoles	103
4.8.	Modern Experiments Related to the Controversy Ampère Versus Grassmann	108
Cha	apter 5 / Faraday's Law of Induction	118
5.1.	Faraday's Law	118
5.2.	Franz Neumann	122
5.3.	Derivation of Faraday's Law from Weber's Force	126
5.4.	Derivation of Faraday's Law from Weber's Electrodynamics Without	
	Utilizing Fechner's Hypothesis	134
Cha	apter 6 / Forces of Weber and of Lorentz	142
6.1.	Introduction	142
6.2.	Retarded and Liénard-Wiechert's Potentials	143
6.3.	Derivation of Grassmann's Force from the Liénard-Schwarzschild's Force	148

viii

Table of Contents	ix	
6.4. Comparison Between Weber's Force and Liénard-Schwarzschild's Force	150	
6.5. Two Charges in Uniform Rectilinear Motion	153	
6.6. Electric Field Due to a Stationary, Neutral and Constant Current	161	
6.7. Weber's Law and Mass Variation	169	
6.8. Darwin's Lagrangian	177	
Chapter 7 / Important Topics Related to Weber's Law	180	
7.1. Two Body Problem According to Weber's Law	180	
7.2. Motion of a Charge Orthogonal to the Plates of a Capacitor	189	
7.3. Charged Spherical Shell	193	
7.4. Centrifugal Electrical Force	199	
7.5. Weber's Law Applied to Gravitation	203	
7.6. Mach's Principle	208	
7.7. The Mach-Weber Model	215	
Chapter 8 / General Discussion	223	
8.1. Weber's Electrodynamics and Maxwell's Equations	223	
8.2. Action at a Distance Versus Contact Action	227	
8.3. Weber's Electrodynamics in Terms of Fields and Retarded Time	232	
8.4. Weber's Law and Plasma Physics, Quantum Mechanics, Nuclear Physics, Etc.	234	
8.5. Limitations of Weber's Electrodynamics	236	
Appendix A / The Origins and Meanings of the Magnetic Force		
$ec{F}=qec{v} imesec{B}$	238	
Appendix B / Alternative Formulations of Electrodynamics		
References		
Index	270	