

Contents

1	Foundation of Electromagnetic Theory	1
1.1	Introduction	1
1.2	Vector Analysis	2
1.2.1	Vector Algebra	2
1.2.2	Vector Gradient	8
1.2.3	Vector Integration	10
1.2.4	Vector Divergence	12
1.2.5	Vector Curl	14
1.2.6	Vector Differential Operator	14
1.3	Further Developments	15
1.4	Electrostatics	19
1.4.1	Coulomb's Law	19
1.4.2	The Electric Field	22
1.4.3	Gauss's Law	23
1.5	Solution of Electrostatic Problems	26
1.5.1	Poisson's Equation	26
1.5.2	Laplace's Equation	27
1.6	Electrostatic Energy	28
1.6.1	Potential Energy of a Group of Point Charges	28
1.6.2	Electrostatic Energy of a Charge Distribution	29
1.6.3	Forces and Torques	31
1.7	Maxwell's Equations	34
1.8	Debye Length	36
1.9	Physics of Plasmas	38
1.10	Fluid Description of Plasma	39
1.11	MHD	42
	References	44

2	Principles of Plasma Physics	45
2.1	Introduction	45
2.2	Barrier Penetration	49
2.3	Calculation of Coulomb Barrier	50
2.4	Thermonuclear Fusion Reactions	55
2.5	Rates of Thermonuclear Reactions	58
2.6	Thermonuclear Fusion Reactions	61
2.7	Critical Ignition Temperature for Fusion	71
2.8	Controlled Thermonuclear Ideal Ignition Temperature	74
2.9	Bremsstrahlung Radiation	77
2.10	Bremsstrahlung Plasma Radiation Losses	82
2.11	Bremsstrahlung Emission Rate	84
2.12	Additional Radiation Losses	89
2.13	Inverse Bremsstrahlung in Controlled Thermonuclear ICF and MCF	92
	References	97
3	Confinement Systems for Controlled Thermonuclear Fusion	99
3.1	Introduction	99
3.2	Magnetic Confinement	101
	3.2.1 Summary of the Guiding Center Drift	123
3.3	How the Tokamak Reactors Works	124
3.4	Inertial Confinement	131
	References	140
	Index	141

Plasma Physics and Controlled Thermonuclear
Reactions Driven Fusion Energy

Zohuri, B.

2016, XIV, 142 p. 70 illus., 31 illus. in color., Hardcover

ISBN: 978-3-319-47309-3