

Contents

<i>Preface</i>	page vii
<i>Acknowledgments</i>	ix
1 Gauss's law for electric fields	1
1.1 The integral form of Gauss's law	1
The electric field	3
The dot product	6
The unit normal vector	7
The component of $\vec{E}$ normal to a surface	8
The surface integral	9
The flux of a vector field	10
The electric flux through a closed surface	13
The enclosed charge	16
The permittivity of free space	18
Applying Gauss's law (integral form)	20
1.2 The differential form of Gauss's law	29
Nabla – the del operator	31
Del dot – the divergence	32
The divergence of the electric field	36
Applying Gauss's law (differential form)	38
2 Gauss's law for magnetic fields	43
2.1 The integral form of Gauss's law	43
The magnetic field	45
The magnetic flux through a closed surface	48
Applying Gauss's law (integral form)	50
2.2 The differential form of Gauss's law	53
The divergence of the magnetic field	54
Applying Gauss's law (differential form)	55

vi	<i>Contents</i>	
3	Faraday's law	58
3.1	The integral form of Faraday's law	58
	The induced electric field	62
	The line integral	64
	The path integral of a vector field	65
	The electric field circulation	68
	The rate of change of flux	69
	Lenz's law	71
	Applying Faraday's law (integral form)	72
3.2	The differential form of Faraday's law	75
	Del cross – the curl	76
	The curl of the electric field	79
	Applying Faraday's law (differential form)	80
4	The Ampere–Maxwell law	83
4.1	The integral form of the Ampere–Maxwell law	83
	The magnetic field circulation	85
	The permeability of free space	87
	The enclosed electric current	89
	The rate of change of flux	91
	Applying the Ampere–Maxwell law (integral form)	95
4.2	The differential form of the Ampere–Maxwell law	101
	The curl of the magnetic field	102
	The electric current density	105
	The displacement current density	107
	Applying the Ampere–Maxwell law (differential form)	108
5	From Maxwell's Equations to the wave equation	112
	The divergence theorem	114
	Stokes' theorem	116
	The gradient	119
	Some useful identities	120
	The wave equation	122
	<i>Appendix: Maxwell's Equations in matter</i>	125
	<i>Further reading</i>	131
	<i>Index</i>	132