CONTENTS

I. INTRODUCTION 1

1.1. Defining a 'surface wave' 4

II. CONDITIONS FOR THE SUPPORT OF SURFACE WAVES AT AN INTERFACE BETWEEN TWO DIFFERENT HOMOGENEOUS MEDIA 6

2.1. Field components 6

2.1.1. The inhomogeneous plane wave, or Zenneck wave 6

2.1.2. The radial cylindrical surface wave 10

2.1.3. The axial cylindrical surface wave 12

2.2. Surface impedance 15

2.2.1. The plane Zenneck wave and the radial cylindrical wave 17

2.2.2. The axial cylindrical wave 20

2.3. Propagation coefficients and phase velocity outside the surface 23

2.3.1. Waves supported by flat surfaces 25

2.3.2. The axial cylindrical wave 25

III. THE SIGNIFICANCE OF THE BREWSTER ANGLE IN RELATION TO SURFACE WAVES 29

IV. THE TILT OF THE EQUI-PHASE SURFACES AND THE EVANESCENT STRUCTURE OF THE ZENNECK WAVE IN THE TRANSVERSE PLANE 34

V. POWER CARRIED BY SURFACE WAVES 38

5.1. The Zenneck wave 38

5.2. The axial cylindrical wave 38

VI. NUMERICAL CALCULATIONS TO ILLUSTRATE THE BEHAVIOUR OF SURFACE WAVES 42

6.1. Zenneck waves 42

6.1.1. Unloaded metal surface 42

6.1.2. Loaded metal surface 42

6.1.3. Sea water surface 43

6.2. Axial cylindrical wave supported by a bare copper wire 44

VII. THE AZIMUTHAL SURFACE WAVE SUPPORTED BY A CYLINDRICAL SURFACE 46

7.1. Calculation for the power radiated 48

7.2. Calculation for the surface impedance 49

7.3. Calculation for the power circulating around the cylindrical surface and its rate of attenuation 51

7.4. The effect on the power radiated of a field 'reflected' outside the supporting surface 53

7.5. The effect of losses in the supporting surface 54

VIII. OTHER TYPES OF SURFACE WAVE 55
8.1. *H*-modes over a plane reactive surface 55
8.2. Surface-wave modes supported by circular cylinders 60
8.2.1. General results 60
8.2.2. Results for particular structures 69
8.3. Miscellaneous surface waves 75

IX. THE EXCITATION OF SURFACE WAVES 77
9.1. General considerations applying to launchers for the Zenneck wave 77
9.2. Electromagnetic fields as plane-wave spectra 79
9.3. A general expression for the amplitude of a surface wave 82
9.4. Launching efficiency 85
9.5. Reception of a surface wave 87
9.6. Reception of a radiated wave 90

X. APERTURE TYPE LAUNCHERS 92
10.1. Launching of Zenneck waves 93
10.1.1. Cullen's solution 93
10.1.2. Booker–Clemmow solution 96
10.1.3. Comparison of results 101
10.2. Launching efficiency 104
10.2.1. Power transmitted by surface wave 104
10.2.2. Radiated power 105
10.2.3. Alternative derivation of the total power passing through the aperture 106
10.3. Numerical results 108
10.3.1. Slot launchers 108
10.3.2. Aperture launchers 113
10.3.3. Experimental results 114

XI. IMPEDANCE CONDITIONS IN RELATION TO SURFACE-WAVE LAUNCHERS 117
11.1. Calculation of the stored energy 118
11.2. The design of a wide-band launcher 120
11.3. Calculation of the input impedance of a surface-wave launcher 126

XII. RADIATION AT DISCONTINUITIES 137
12.1. Radiation at a reactance discontinuity 137
12.1.1. Theoretical analysis 137
12.1.2. Discussion of the solution 140
12.2. Approximate methods for estimating the effect of a discontinuity 142
12.3. Some approximate solutions 146
12.3.1. Bends and corners 146
12.3.2. The effect of a thin conducting strip 149

XIII. APPLICATION OF SURFACE WAVES 151
13.1. Transmission systems 151
13.2. Surface-wave aerials 155
13.2.1. General description 155
13.2.2. Control of radiation from surface-wave aerials 161
13.2.3. Waves on surfaces with modulated reactance 167

APPENDIXES
1. Generalization of the Fourier cosine transform 171
2. Integration contours required in Section 10.1.3 173
3. Wiener–Hopf methods 176

REFERENCES 187

NAME INDEX 197

SUBJECT INDEX 199