UNIVERSITY OF CALIFORNIA

GRADUATE DIVISION, NORTHERN SECTION

PROGRAM OF THE FINAL EXAMINATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

OF

FREDERICK BERNARD WOOD

B.S. (University of California) 1941

M.S. (University of California) 1948

ELECTRICAL ENGINEERING

MONDAY, MAY 4, 1953, AT 2:00 P.M., IN ROOM 125

CORY HALL

COMMITTEE IN CHARGE:

Professor LAURISTON CALVERT MARSHALL, *Chairman*,
Associate Professor CHAIM RICHMAN,
Professor SAMUEL SILVER,
Doctor PAUL L. CHAMBRÉ,
Associate Professor DAVID HAROLD SLOAN.

BIOGRAPHICAL

1917 —Born in Sacramento, California.

1941 —B.S., University of California.

1941–1944—Staff Member, Radiation Laboratory, Massachusetts Institute of Technology.

1944–1946—Section Chief, Radiation Laboratory, Massachusetts Institute of Technology.

1948 —M.S., University of California.

1946–1949—Harry H. Hilp Fellow in Engineering, University of California.

1946–1952—Graduate Student in Electrical Engineering, University of California.

1952– —Technical Engineer, Research and Development Laboratory, International Business Machines Corporation, San Jose.

DISSERTATION

Coupling between Waveguides and Cavity Resonators for Large Power Output

This study is principally an analysis of the coupling of waveguides and cavity resonators and the development of approximation methods suited to calculations for large irises. Comparison of theory with experiment shows that Bethe's lumped constants for small irises can be extended in special cases to intermediate size irises. In general, however, for irises of medium or large size, it is necessary to start with fundamental principles, then introduce approximations suited to a particular case.

Approximate dyadic Green's functions for cavity resonators having walls of finite conductivity are developed by substitution of eigen-values derived from the theory of perturbation of boundary conditions. The effect of wall losses is lumped into the characteristic admittance coefficients in the Green's functions. This form gives the correct input admittance as would be observed at a distance down the waveguide, provided the limiting conditions are satisfied.

The integral equation for the input admittance of a resonator coupled through an iris to a waveguide is set up by use of the dyadic Green's functions. A simple equivalent circuit is obtained from the integral equation. The admittances on the waveguide and on the resonator sides of the iris are each shown to be stationary with respect to first order variations of the iris field. The transformer ratio in the equivalent circuit is shown to be stationary when both the resonator and the waveguide fields have the same form at the iris.

The equation for the coupled Q of a resonator is obtained by taking the derivative of the input admittance with respect to frequency. The special case of a rectangular resonator which can be treated as a short-circuited transmission line is solved by use of simplifying assumptions. These results are put in a form useful for quick approximate calculation of the coupled Q and resonant frequency of iris-coupled resonators having a similar field distribution near the iris.

The coupled Q and resonant frequency of a coaxial resonator in the $TEM_{0,0,3}$-mode are calculated by use of the rectangular resonator approximation for the complete range of iris sizes covered by the experiments. Excellent agreement is obtained between theory and experiment for inductive irises. When the width of the iris approaches a half-wavelength, the theoretical curves of the coupled Q depart from the experimental curves. For thin capacitive irises a more detailed calculation of the coupled Q is made by direct use of the coaxial resonator Green's functions using the resonant frequencies from the first approximation. This higher order approximation gives a theoretical curve of coupled Q as a function of iris width which comes closer to the shape of the experimental curve.

Field of Study: ELECTRICAL ENGINEERING.

Research: Microwave Cavity Resonator Coupling. Professor L. C. Marshall.

Individual Study: Variational Methods in Diffraction Theory. Dr. C. H. Papas.

Individual Study: Diffraction Theory. Professor J. R. Whinnery.

Advanced Radio Communication. Professor L. E. Reukema.

Bessel Functions and Their Applications to Engineering Problems. Professor L. E. Reukema.

Microwave Networks. Professor J. R. Whinnery.

Other Studies:

Differential Equations. Professors Thomas Buck and Edmund Pinney.

Research in International Economic Relations. Professor J. B. Condliffe.

Function Theory. Professor G. C. Evans.

Theory of Electricity and Magnetism. Professor W. K. H. Panofsky.