COURSE OUTLINE FOR ESE 524 (MICROWAVE ACOUSTICS)

Fall 2011

I. BASIC FIELD THEORY

o *General theory of harmonic waves*

Plane wave characterization, dispersion, phase and group velocities, guided waves, anisotropic propagation

o *Theory of acoustic* waves

Continuum acoustic field theory, strain and stress tensors, constitutive parameters for elastic and piezoelectric media, wave equation, boundary conditions and the Poynting vector; waves in isotropic elastic media [plane SH, SV and P waves; Rayleigh (or SAW) and Love waves]; slowness diagrams; waves in piezoelectric media (piezoelectric stiffening, equivalent stiffness coefficients, electromechanical coupling constants, SAW on piezoelectric substrates)

II. BULK ACOUSTIC WAVE (BAW) TRANSDUCTION AND APPLICATIONS

Delay lines and resonators; the Mason equivalent circuit; analysis of resonator and delay line circuits; monolithic crystal filters; IMCON pulse-compression (or dispersive) delay line; acoustic microscope

III. SAW TRANSDUCTION AND APPLICATIONS

Interdigital transducer (IDT) and its equivalent circuit; IDT impulse response and its relationship to the overlap between EDT fingers and their spacing; IDT as a transversal filter; design of a SAW bandpass filter; multistrip couplers; SAW nondispersive and dispersive bandpass filters; matched filtering with bi-phase coded signals; convolvers; applications of SAW to systems

IV. ACOUSTO-OPTICS

Basic theory of acousto-optics; acousto-optic devices

REFERENCES

(1) J.P. Parekh, "Microwave acoustics", *in Fundamentals Handbook of Electrical and Computer Engineering, Vol. 1* (John Wiley & Sons, 1982)

(2) A.A. Oliner, *editor*, "Acoustic surface waves" (Springer Verlag, New York, 1978)

(3) H. Matthews, *editor*, "Surface-wave filters" (John Wiley & Sons, 1977)

(4) B.A. Auld, "Acoustic fields and waves in solids" (John Wiley & Sons, 1973)