**Review Final**
**EE 5347**

**Final Exam: Thursday Dec. 16, 2010 2:00 - 4:30 PM**
Closed book closed notes, no calculators
This and review sheets for exam 1 and exam 2 should be used for the final exam.

**Broadband Directional Coupler** $S_{41} = \Gamma_e$ implies coupling of a coupler is the same as the reflection coefficient of a transformer with impedance steps of $Z_{0e}$.

$$Z_0^2 = Z_0 Z_{0e}$$

ABCD Matrix for a transmission line with characteristic impedance $Z_{0e}$

$$\frac{1}{\sqrt{1 - S^2}} \begin{bmatrix} 1 & S Z_{0e} \\ S / Z_{0e} & 1 \end{bmatrix}$$

"Coupling Coefficient"

$$\frac{Z_{0e}}{Z_0} = \left[ \frac{1 - k}{1 + k} \right]^{1/2}$$

"Coupling"

$$\frac{Z_{0e} (L/2)}{Z_0} = \frac{1 + |C_\infty|}{1 - |C_\infty|}$$

$$k' = \frac{Z_0}{Z_{0e} (L/2)}$$

Significance of the Riccati equation and its approximate solution and Fourier Transform pair.
Difference between 180° and 90° couplers.
For the 180° coupler, the Klopfenstein taper is useful.

$$\rho e^{j\beta L} = \rho_0 \frac{\cos \sqrt{(\beta L)^2 - A^2}}{\cosh A}$$

where

$$A = \beta_0 L$$

$$\rho_{rip} = \frac{\rho_0}{\cosh A}$$
For the 90° coupler, design technique note maximum coupling and analogy with impedance transformer.
Characteristic impedance distinctions for waveguide.
Forms of equivalent circuits of discontinuities

**Physical Realization**
- Coaxial impedance change
- Stripline impedance change
- Stripline open end effect
- Microstrip impedance change
- Microstrip end effect
- Accommodation of impedance step discontinuities.

**Wilkinson Divider**
Know the basic physical operation of the Wilkinson Divider/Combiner.

**Lange Couplers**
TEM assumptions regarding $Z_{mn} = 1/v_p C_{mn}$
Even and odd mode velocities are equal.
Equivalent capacitance matrix for 4 finger Lange Coupler.
Method of finding dimensions from equivalent 2 line coupler, $Z_{0e}$ vs. $Z_{0e4}$ etc.