ECE 594I Syllabus: Fall 2008

- History of THz Field and THz Radiative Phenomenology: blackbody radiation, Kirchoff's relation, and propagation through common materials (vapor, solids, and liquids) at THz frequencies
- Electromagnetics and Propagation Components: skin-effect losses, diffraction effects, surface roughness effects; waveguides, transmission lines, antenna types, etc.
- Coherent Sources: multiplication up from RF region and difference-frequency generation from optical lasers; transistor amplifiers, FET- and HBT-based; vacuum-based devices.
- Passive Detection and Sensor Principles: direct and coherent detection with and without pre-amplification, sources of noise, radiometry, system sensitivity metrics (e.g. NEP and NETD), system resolution metrics (spatial and spectral).
- Active Detection and Sensor Principles: transmitter types and associated waveform, detection mechanism (direct, coherent and in-between), effect of noise, radar-range equation, statistical detection theory based on maximum-likelihood criteria; probabilities of detection, false-alarm, etc.; receiver-operating characteristics (ROCs)
- THz Systems and Applications: radio astronomy, molecular spectroscopy (gas, liquid, and solid states), imaging of concealed objects, imaging of biological materials.

Optional Topics (will be chosen after Student Feedback)

- Electron Transport in Bulk Solids at THz Frequencies: the transition from semiclassical to quantum transport; collective excitations: optical phonons, plasmons, etc.
- Quantum Effects: quantum size effects in quantum wells, superlattices, and quantum dots; magnetic effects including cyclotron resonance of free carriers and electron-spin resonance of bound electrons via Zeeman effect.