**DEPARTMENT OF ELECTRICAL ENGINEERING**
**The Ohio State University**
**Course Syllabus**

**ECE 832** **High Speed Semiconductor Devices** **Spring 2012**

**Prerequisite:** ECE730 or ECE432 with instructor permission

**Textbook:** High-Speed Heterostructure Devices, P. Roblin and H. Rohdin, *Cambridge University Press*, 2002

**Instructor:** Patrick Roblin, 292-0998, Room 379 Caldwell Lab

**Lecture Schedule:** Room: KN 195 (Knowlton Architecture building), MWF 12:30 am

**Office Hours:** By appointment. Otherwise use e-mail for lecture and homework questions

**Course Plan:**

- 1. Introduction to Heterostructure Devices. Semi-Classical Theory, HBT.
- 2. Quantum Theory of Heterostructures and Quantum Heterostructure Devices (Quantum well, RTD, superlattice)
- 3. Scattering Processes and Scattering-Assisted Tunneling in Heterostructures Devices and High-Frequency Response of Quantum Devices (RTD, Infrared laser)
- 4. Charge Control of the Two-Dimensional Electron Gas in HEMT
- 5. High Electric-Field Transport in Semiconductor Devices
- 6. Current Voltage Models of the Short-Channel MOSFET, HEMT,SOI and LDMOS
- 7. MOSFET Wave-Equation. Microwave Modeling and Electrothermal effects.
- 8. Noise modeling. On wafer microwave measurement.
- 9. High-Frequency Heterojunction Bipolar Transistors
- 10. Non-linear RF measurement and modeling. Impact of thermal and electrical memory effect on linearization.

**Grading Scheme:** HW: 1/3, Take home midterm: 1/3, Take home Final: 1/3

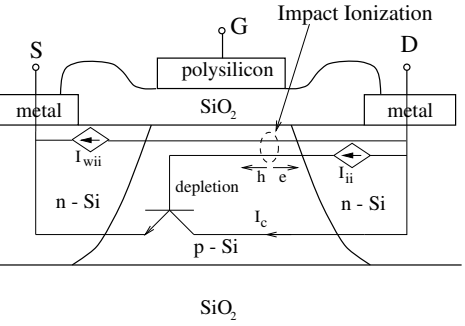
**Class Webpage:** http://eewww.eng.ohio-state.edu/∼roblin/ee832.html

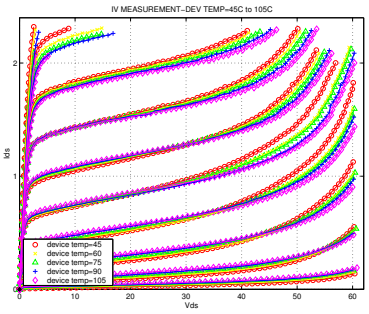
*All examinations in this course will be administered in accordance with the ECE Honor System. If you have a question about the ECE Honor System, contact your instructor or a member of the ECE Student Council.*

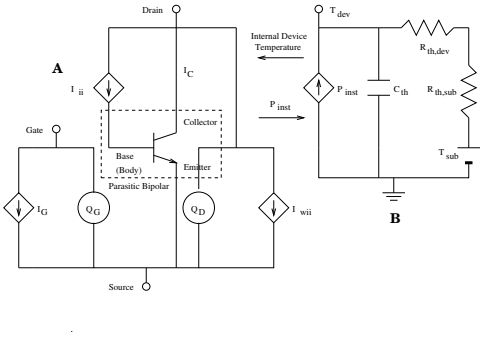
## 2012 Special Topics:

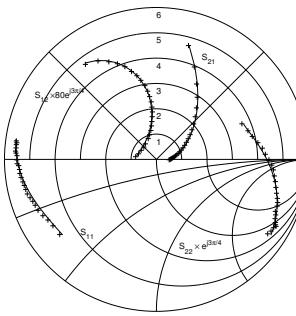
*Modeling and Measurement of Transistors for RFIC and high-power RF PA*

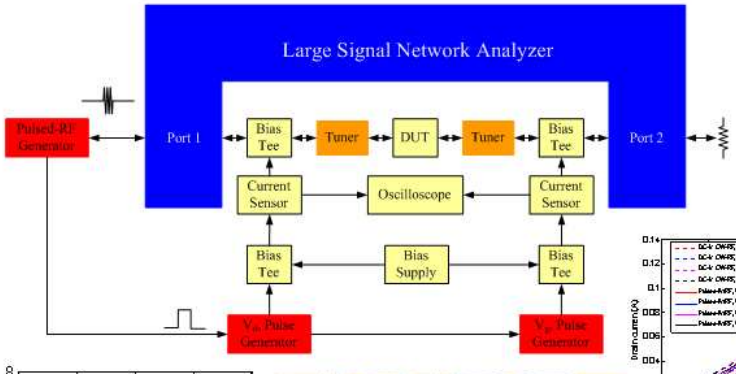
- GaN HEMTs: physics, modeling and high-power density applications
- Non-linear RF characterization with a Large Signal Network Analyzer
- Impact of self-heating & traps on transistor characteristics
- Pulsed-IV pulsed-RF measurements as a probe of device physics
- Joint LSNA / DLOS measurements of GaN HEMTs
- On-wafer RF measurements, deembedding, Cold FET parasitics extraction
- 1/f noise and cyclostationary effect under large-signal operation

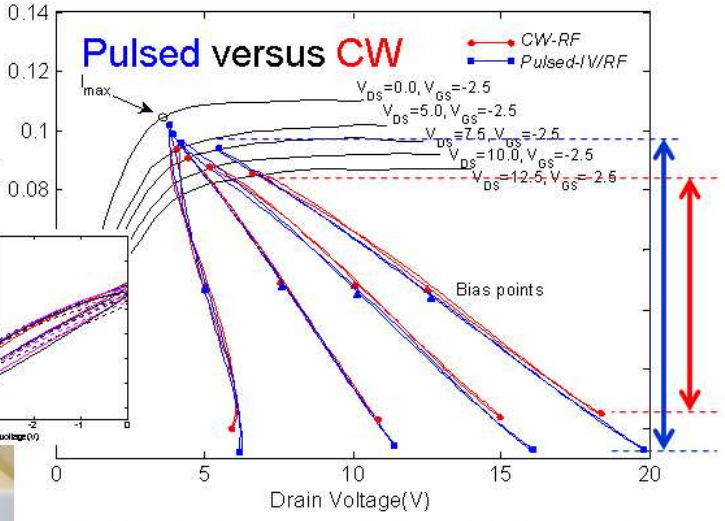


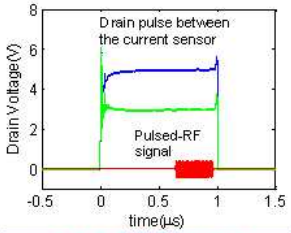



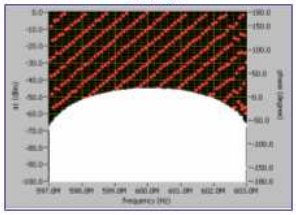



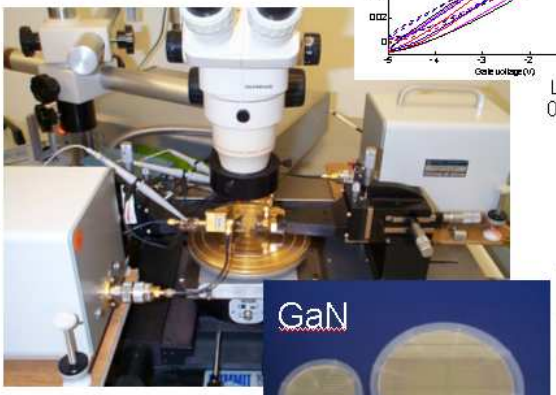










**Effective suppression of IV knee walk-out in AlGaN/GaN HEMTs !**

| | Type | $V_{DS}$=5.0 | $V_{DS}$=7.5 | $V_{DS}$=10.0 | $V_{DS}$=12.5 |
|---|---|---|---|---|---|
| 1 | CW | 90 % | 85 % | 81 % | 78 % |
| 2 | Pulsed Gate & Drain | 105 % | 100 % | 98 % | 96 % |