# ECE 597/697DM — Post-CMOS Materials and Devices

Department of Electrical and Computer Engineering
University of Massachusetts at Amherst
**Spring 2019**

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**Day & Time**: Tue/Thu: 10:00-11:15 Am
**Place**: TBD
**Instructor**: Prof. Jianhua (Joshua) Yang, (201G Marcus Hall, jjyang@umass.edu)
**Office Hours**: Tue 1:00-3:00 pm or by appointments

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**Course Description**
Since traditional CMOS devices cannot meet the needs in the so-called 'big data' and Internet of Things (IoT) era, the world research community is aggressively searching for novel materials and devices beyond CMOS. This course will cover the fundamentals of materials and emerging electronic devices (e.g. Memristors and Spintronics ) used as logic, memory, storage, sensor and display. Novel computing paradigms enabled by these emerging devices will also be introduced. Recent progress, current challenges and future directions will also be reviewed and discussed.
The course is intended to be self-contained by covering materials, devices and applications.

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## Course Goals

• To introduce basic materials science knowledge: thermodynamics, kinetics, properties, characterizations.

• To introduce emerging electronic and ionic devices: mechanisms, structure, promises, challenges.

• To survey recent progress of unconventional computing enabled by emerging devices.

## Lecture Topics:

• Materials basics (structure, defects, classifications, bonds etc.)

• Electronic properties of materials (electrical, magnetic etc.)

• Thermodynamics and applications

• Kinetics and applications

• Thin films deposition and growth

• Materials characterization techniques

• Emerging Memory devices

• Emerging Logic devices

• Brain-inspired computing

• Novel applications of emerging devices

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**Course Materials**

Lectures and lecture notes are the primary course materials.

**Recommended Textbooks**

- Materials Science Of Thin Films, by Milton Ohring, Academic Press, 2002. 2nd Ed.
- Electronic Properties of Materials, by Rolf E. Hummel, Springer, 2001, 3rd Ed.
- Materials Science and Engineering: An Introduction, by William D. Callister and David G. Rethwisch, Wiley, 2013, 9rd Ed.

**Useful Reference Textbooks**

- Materials Thermodynamics, by Y. Austin Chang and W. Alan Oates, Wiley, 2010.
- Nanoelectronics and Information Technology, by Rainer Waser, Wiley-VCH, 2012, 3rd Ed.
- Physics of Semiconductor Devices, by Simon. M. Sze, Wiley, 2006, 3rd Ed.

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**Grading**

Homework - 10%
Midterm Exam - 30%
Final Exam - 30%
Course Project – 30%

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