### Cover Sheet: Request 13589

**EEL4XXX Modern Memory Device Technologies**

#### Info

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<td>Shannon Chillingworth <a href="mailto:schill@ece.ufl.edu">schill@ece.ufl.edu</a></td>
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#### Actions

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<td>ENG - College of Engineering</td>
<td>Heidi Dublin</td>
<td>Approved by HWCOE Curriculum Committee and Faculty Council</td>
<td>3/15/2019</td>
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Course|New for request 13589

Info

Request: EEL4XXX Modern Memory Device Technologies
Description of request: New Course Request
Submitter: Shannon Chillingworth schill@ece.ufl.edu
Created: 2/6/2019 2:10:27 PM
Form version: 1

Responses

Recommended Prefix EEL
Course Level 4
Number XXX
Category of Instruction Advanced
Lab Code None
Course Title Modern Memory Device Technologies
Transcript Title MDRN MEMORY DEV TECH
Degree Type Baccalaureate

Delivery Method(s) On-Campus
Co-Listing Yes
Co-Listing Explanation This course is co-listed with the graduate class. The homework portion of the graduate section will involve additional work and more advanced concepts with respect to the undergraduate section. The exams will also involve additional questions for the graduate section with respect to the undergraduate section.

Grading for the homework and projects are different from the undergraduate course. The graduate and undergraduate sections will be graded separately, for which the graduate section has additional problems and different weights for all problems.
Effective Term Earliest Available
Effective Year Earliest Available
Rotating Topic? No
Repeatable Credit? No

Amount of Credit 3
If variable, # min 0
If variable, # max 0
S/U Only? No
Contact Type Regularly Scheduled
Weekly Contact Hours 3

Course Description This course discusses state-of-the-art volatile and nonvolatile memory device technologies and their limitations. It also discusses emerging memory device technologies, including those that could be adopted by industry in the next decades due to their potential performance, density, power and cost advantages.
Prerequisites EEE3396C
Co-requisites None.

Rationale and Placement in Curriculum This course builds on core concepts covered in EEE 3396C and exposes students to topics in memory device technology.
Course Objectives The students are expected to understand (1) state-of-the-art memory technologies, (2) emerging memory technologies for future big data applications, (3) mechanisms and limitations of each memory device technology, (4) memristive devices for neuromorphic computing.

Course Textbook(s) and/or Other Assigned Reading Required Textbooks and Software
Title: Emerging Nanoelectronic Devices
Author: An Chen et al.
ISBN number: 978-1118447741

Weekly Schedule of Topics Course Schedule
Week 1: Brief introduction of field-effect transistors
Week 2-3: State-of-the-art volatile memory devices: DRAM
Week 4-5: SRAM memory device technology (homework 1 due)
Week 6-7: Flash memory technology
Week 8: Spin transfer torque memory devices (homework 2 due)
Week 9: Phase change memory devices
Week 9: Midterm Exam
Week 10: Resistive memory devices (homework 3 due)
Week 11: Crossbar architecture
Week 12-13: Device models of memristors (homework 4 due)
Week 14: Other devices for neuromorphic computing
Week 15-16: Final project and presentation

Links and Policies
Attendance Policy, Class Expectations, and Make-Up Policy
Excused absences are consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.

Grading Policy:

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or concerns, please consult with the instructor or TAs in this class.

Software Use
All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Campus Resources:

Health and Wellness

U Matter, We Care:
If you or a friend is in distress, please contact umatter@ufl.edu or 352-392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.


Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.


Grading Scheme Evaluation of Grades:

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This course is co-listed with the graduate class. The homework portion of the graduate section will involve additional work and more advanced concepts with respect to the undergraduate section. The exams will also involve additional questions for the graduate section with respect to the undergraduate section.

Grading for the homework and projects are different from the undergraduate course. The graduate
and undergraduate sections will be graded separately, for which the graduate section has additional problems and different weights for all problems.

The final project shall be on the topics of memory device technologies learned throughout the course, and consist of the following parts (i) Motivation (ii) Background, (iii) Technical Approach (iv) Results, (v) Discussions, and (vi) conclusions. It will be graded according to the following percentages: 30% for parts (i) and (ii), 45% for parts (iii) and (iv), 25% for parts (v) and (vi). Parts (i), (ii) and (v) shall discuss relations and comparisons between various memory device technologies discussed in the course, and parts (ii) and (iv) can focus specifically on one memory device technology.

Instructor(s) Dr. Jing Guo
Modern Memory Device Technologies
EEL 4XXX  Section #XXX
Class Periods:  TBD
Location:  TBD
Academic Term:  TBD

Instructor
- Name:  Jing Guo
- Email Address:  guoj@ufl.edu
- Office Phone Number:  NEB 551
- Office Hours:  TBD

Teaching Assistants:
Please contact through the Canvas website
- Name of TA, email address, office location, office hours
- Name of TA, email address, office location, office hours

Course Description
Discusses state-of-the-art volatile and nonvolatile memory device technologies and their limitations. Discusses emerging memory device technologies, including those that could be adopted by industry in the next decades due to their potential performance, density, power and cost advantages. 3 credit hours.

Course Pre-Requisites / Co-Requisites
EEE 3396C

Course Objectives
The students are expected to understand (1) state-of-the-art memory technologies, (2) emerging memory technologies for future big data applications, (3) mechanisms and limitations of each memory device technology, (4) memristive devices for neuromorphic computing.

Materials and Supply Fees
N/A

Professional Component (ABET)
This course consists of 1.5 credits of Engineering Design and 1.5 credits of Engineering Science

Relation to Program Outcomes (ABET)
Engineering Criteria
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
6. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE Program Criteria:
EE2 - knowledge of mathematics, basic and engineering sciences necessary to analyze and design complex systems
EE3 - knowledge of advanced mathematics including linear algebra, complex variables and discrete mathematics

Required Textbooks and Software
- Title: Emerging Nanoelectronic Devices
- Author: An Chen et al.
- ISBN number: 978-1118447741
- Software: None
(if course notes derived from various published sources are used, provide information above for each source)
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Recommended Materials
- None

Course Schedule
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Academic Resources

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Modern Memory Device Technologies
EEL 5XXX  Section XXX

Class Periods:  TBD
Location:  TBD
Academic Term:  TBD

Instructor:
• Name: Jing Guo
• Email Address: guoj@ufl.edu
• Office Phone Number: NEB 551
• Office Hours: TBD

Teaching Assistants:
Please contact through the Canvas website
• Name of TA, email address, office location, office hours
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Course Description
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Course Pre-Requisites / Co-Requisites
Solid State Devices

Course Objectives
The students are expected to understand (1) state-of-the-art memory technologies, (2) emerging memory technologies for future big data applications, (3) mechanisms and limitations of each memory device technology, (4) memristive devices for neuromorphic computing.

Materials and Supply Fees
NA

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Week 15-16: Final project and presentation

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<td>B-</td>
<td>2.67</td>
</tr>
<tr>
<td>77.0 – 79.9</td>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>73.0 – 76.9</td>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>70.0 – 72.9</td>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>67.0 – 69.9</td>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>63.0 – 66.9</td>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>60.0 – 62.9</td>
<td>D-</td>
<td>0.67</td>
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<tr>
<td>0 – 59.9</td>
<td>E</td>
<td>0.00</td>
</tr>
</tbody>
</table>
In order to graduate, graduate students must have an overall GPA and a major GPA of 3.0 or better (B or better). Note: A “B-” average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement.

More information on UF grading policy may be found at: http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020

Students Requiring Accommodations
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation
Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu/evals. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (https://www.dso.ufl.edu/sscr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use
All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Campus Resources:

Health and Wellness

<table>
<thead>
<tr>
<th>U Matter, We Care:</th>
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<tbody>
<tr>
<td>If you or a friend is in distress, please contact <a href="mailto:umatter@ufl.edu">umatter@ufl.edu</a> or 352-392-1575 so that a team member can reach out to the student.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Counseling and Wellness Center:</th>
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<tbody>
<tr>
<td><a href="http://www.counseling.ufl.edu/cwc">http://www.counseling.ufl.edu/cwc</a>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.</td>
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<tr>
<th>Sexual Assault Recovery Services (SARS)</th>
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<tbody>
<tr>
<td>Student Health Care Center, 392-1161.</td>
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</table>

<table>
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<tr>
<th>University Police Department</th>
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</thead>
<tbody>
<tr>
<td>at 392-1111 (or 9-1-1 for emergencies), or <a href="http://www.police.ufl.edu/">http://www.police.ufl.edu/</a>.</td>
</tr>
</tbody>
</table>

Academic Resources
EEL 5XXX- Modern Memory Device Technologies
Jing Guo and TERM YEAR
E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. [https://lss.at.ufl.edu/help.shtml](https://lss.at.ufl.edu/help.shtml).

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. [https://www.crc.ufl.edu/](https://www.crc.ufl.edu/).

Library Support, [http://cms.uflib.ufl.edu/ask](http://cms.uflib.ufl.edu/ask). Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. [https://teachingcenter.ufl.edu/](https://teachingcenter.ufl.edu/).

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. [https://writing.ufl.edu/writing-studio/](https://writing.ufl.edu/writing-studio/).

Student Complaints Campus: [https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)