

# Introduction to Semiconductor Packaging

## ***Course Description***

Focuses on Fundamentals of Semiconductor Packaging including materials and substrates and assembly processes involved in advanced packaging, testing and reliability of Advanced Packaging and uses in current industry **Lecture. Credits 3.**

## ***Course Pre-Requisites / Co-Requisites***

- Basic understanding of the physical structure of microelectronics

## ***Course Objectives***

- The focus of this course is to first address the fundamentals of semiconductor packaging evolution, current technology, and future developments in advanced semiconductor packaging. More than ten modules will be discussed in this course to cover all topics of this aspect.
- In addition, this course provides an in-depth and intriguing overview of the dynamic world of advanced packaging, including topics such as package assembly, interconnects, substrates, and advanced packaging materials.
- This course delves into the influence of advanced packaging on contemporary semiconductor devices.
- This course also highlights testing and reliability aspects of advanced semiconductor packaging. Along with Thermal Management aspects involved in advanced packaging.
- Furthermore, this course will introduce the opportunities and challenges and provide a clear direction of the requirements for advanced packaging and its uses in the current industry.

### ***Materials and Supply Fees***

N/A

### ***Required Textbooks and Software***

- Course lectures and notes are developed by the instructor.

### ***Recommended Materials***

- Semiconductor Advanced Packaging by John H. Lau
- Title
- Author
- Publication date and edition
- ISBN number

### ***Course Schedule***

<b>Week</b>	<b>Topics</b>	<b>Description</b>
1	Introduction to IC Packaging	<ul style="list-style-type: none"><li>• Definition of packaging and its significance in various industries.</li><li>• Introduction to packaging and its importance in Modern Electronics.</li><li>• Provide an overview of the course structure and learning objectives.</li></ul>
2	Traditional Packaging Technologies I	<ul style="list-style-type: none"><li>• Exploring different packaging technologies, such as leaded and leadless packages, surface mount technology (SMT), and ball grid array (BGA).</li></ul>

3	Traditional Packaging Technologies II	<ul style="list-style-type: none"> <li>• Discussion on the purpose and characteristics of each technology.</li> <li>• Explanation of the factors influencing technology selection</li> </ul>
4	Introduction to Advanced Packaging I	<ul style="list-style-type: none"> <li>• Definition of advanced packaging and its importance in meeting evolving technology requirements.</li> </ul>
5	Introduction to Advanced Packaging II	<ul style="list-style-type: none"> <li>• Explaining the benefits and challenges associated with advanced packaging.</li> <li>• Exploring different integrated technology of advanced packaging technologies, such as 2.5D, 3D packaging,</li> </ul>
6	Advanced Packaging Interconnects I	<ul style="list-style-type: none"> <li>• Discussion on interconnect technologies used in advanced packaging, such as flip chip bumping, solder balls, and through-silicon vias (TSVs), photonic integration.</li> </ul>
7	Advanced Packaging Interconnects II	<ul style="list-style-type: none"> <li>• Explanation of the working principles and considerations for each interconnect technology.</li> <li>• Highlight their impact on electrical performance and signal integrity.</li> </ul>

### **MID TERM EXAMINATION**

8	Advanced Packaging Materials and Substrates I	<ul style="list-style-type: none"> <li>• Detail the substrates and materials used in advanced packaging, such as organic substrates, build-up substrates, and redistribution layers (RDLs), interposers, fan-out substrate.</li> </ul>
9	Advanced Packaging Materials and Substrates II	<ul style="list-style-type: none"> <li>• Explaining substrates and materials, their properties, fabrication techniques, and performance characteristics.</li> <li>• Discussion on the selection criteria for different advanced packaging applications.</li> </ul>
10	Thermal Management in Advanced Packaging I	<ul style="list-style-type: none"> <li>• Introduction to the importance of thermal management in advanced packaging.</li> </ul>
11	Thermal Management in Advanced Packaging II	<ul style="list-style-type: none"> <li>• Discussion on various thermal management techniques, such as heat sinks, thermal interface materials (TIMs), and thermal vias.</li> <li>• Explanation of the design considerations for effective thermal management.</li> </ul>

12	Testing and Reliability in Advanced Packaging I	<ul style="list-style-type: none"> <li>• The testing methodologies and reliability considerations specific to advanced packaging.</li> <li>• Discussion on package-level testing, interconnect testing, and reliability testing.</li> </ul>
13	Testing and Reliability in Advanced Packaging II	<ul style="list-style-type: none"> <li>• Explanation of various failure analysis techniques and strategies for ensuring package reliability.</li> </ul>
14	Future Trends and Emerging Technologies	<ul style="list-style-type: none"> <li>• Discussion on emerging trends in advanced packaging and their potential impact</li> <li>• Insights into future developments and opportunities in the field.</li> </ul>
15		Final presentations and reports due

**Final exam (cumulative)**

***Attendance Policy, Class Expectations, and Make-Up Policy***

Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulationsLinks to an external site.>) and require appropriate documentation. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/Links to an external site.>

<b>Assignment</b>	<b>Percentage of Final Grade</b>
Midterm Exam (03/15)	15%
Final Presentation (03/21-04/11)	30%
Final report ( 5% (02/13) + 10% (03/19)+ 25% (04/18) )	40%
Final Exam (04/16)	15%

100%

### ***Grading Policy***

The following is given as an example only.

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

The homework portion for graduate and undergraduate sections will involve different weights and problems. There will be more advanced concepts for the graduate section. The exams will also involve additional questions for the graduate section with

respect to the undergraduate section. Grading for the presentations is different for the undergraduate course. Graduate presentations will include an additional discussion section for challenges in various packaging types and structures.

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)[Links to an external site.](#)

[Grades and Grading Policies](#)[Links to an external site.](#)

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/Links to an external site.> It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/Links to an external site.> Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/Links to an external site.> Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/Links to an external site.>

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the

University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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://sccr.dso.ufl.edu/process/student-conduct-code/>)Links to an external site. 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.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWCOE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students 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.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>[Links to an external site.](#)

### ***Campus Resources:***

#### ***Health and Wellness***

#### ***U Matter, We Care:***

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>[Links to an external site.](#), and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.



## **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**[Links to an external site.](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

## **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/Links to an external site.>

## *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.shtmlLinks to an external site.>

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.eduLinks to an external site.>

**Library Support**, <http://cms.uflib.ufl.edu/askLinks to an external site.> 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/Links to an external site.>

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/Links to an external site.>

**Student Complaints Campus**: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/Links to an external site.>; <https://care.dso.ufl.eduLinks to an external site.>

**On-Line Students Complaints:** <https://distance.ufl.edu/getting-help/>Links to an external site.; <https://distance.ufl.edu/state-authorization-status/#student-complaint>Links to an external site..