



University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Mechanical Engineering
M.S./Ph.D. in Mechanical Engineering



Course Syllabus

1. General Information:
Alpha-numeric codification: INME 6810 Course Title: Mechanical Fundamentals of Electronic Packaging Number of credits: 3 Contact Period: Three hours of lecture per week
2. Course Description:
English: This course covers the fundamental mechanical principles used in the design of electronic devices and their integration into electronic systems. It will focus on the effect of materials compatibility, thermal stress, mechanical stress, and environmental exposure on product performance, durability, and cost. Both electronic devices and package assemblies will be considered. Thermal and mechanical stress effects on package assemblies will be studied.
Spanish: Este curso cubre principios mecánicos fundamentales utilizados en el diseño e integración de empaques electrónicos. El enfoque del curso será en los procesos de manufactura relacionados con cada uno de los niveles de integración, compatibilidad de los materiales, esfuerzos mecánicos/termales, principios de soldadura e interconexiones, y confiabilidad. Se estudiarán los empaques a nivel de componente y de ensamblaje.
3. Pre/Co-requisites and other requirements:
Pre-requisite: Authorization of the Director of the Department
4. Course Objectives:
Upon completion of this course, students should be able to: 1. Describe basic electronic packaging technologies, standard packages, and manufacturing processes steps; 2. Judge current status and future trends in packaging and interconnect technology; 3. Apply the concepts of mechanical design and analysis to common electronic packaging; 4. Apply the concepts of thermal management and analysis to common electronic packaging; 5. Analyze material compatibility issues within electronic packages and provide practical solutions; 6. Assess the reliability of interconnections based on physics-of-failure and statistical analysis. 7. Explain the basics of the manufacturing processes used from device to assembly level.
5. Instructional Strategies:
<input checked="" type="checkbox"/> conference <input type="checkbox"/> discussion <input type="checkbox"/> computation <input type="checkbox"/> laboratory <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop <input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input checked="" type="checkbox"/> special problems <input type="checkbox"/> tutoring <input type="checkbox"/> research <input type="checkbox"/> other, please specify:

6. Minimum or Required Resources Available:

None

7. Course time frame and thematic outline

General Topics	Contact Hours
Fundamentals of Electronic Packaging	3
Semiconductor manufacturing	3
Packaging Overview	4
Die attach	2
Wire bonding	1
Molding compounds	1
Packaging assembly steps	5
Printed circuit boards (PCB)	4
Board assembly and principles of soldering	7
Solder fatigue and failure mechanisms	4
Fundamentals of reliability	3
Pb-free solders	3
Thermal management	3
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System Quantifiable (S/NS) Not Quantifiable**9. Evaluation Strategies**

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	40-50
<input checked="" type="checkbox"/> Final Exam	1	20-25
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20-25
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Assistance		10
TOTAL:		100%

10. Bibliography:**Books:**

1. Ulrich, R.K. and Brown, W. (2006). *Advanced Electronic Packaging*. (2nd Edition). New Jersey: Wiley-Interscience. UPRM General Library Call Number TK7874. A332 2006*
2. Lu, D. and Wong, C.P. (2004). *Materials for Advanced Packaging*. New York: Springer. *
3. Tummala, R. (1988). *Microelectronics Packaging Handbook*. (1st Edition). New York: Van Nostrand Reinhold. UPRM General Library Call Number TK7874 .M485 1989 C.1 *
4. Tummala, R. (2008). *Introduction to System on Package (SOP)*. New York: McGraw-Hill Professional.
5. Modarres, M., Kaminskiy, M. and Krivtsov, V. (2009). *Reliability Engineering and Risk Analysis: A Practical Guide*. (2nd Edition). Florida: CRC Press. (Available in UPRM through CRC netBASE)

Journals:

6. IEEE Transactions on Components and Packaging Technologies
(<http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6144>)**
7. IEEE Transactions on Advanced Packaging
(<http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6040>)**
8. IEEE Transactions on Electronic Packaging Manufacturing
(<http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6104>)**
9. Microelectronics Reliability

Trade Magazines:

Advanced Packaging (<http://www.electroiq.com/index/packaging.html>)

Chip Scale Review (<http://www.chipscalereview.com/issues/1009/index.php>)

Surface Mount Technology (<http://www.electroiq.com/index/surface-mount-technology.html>)

* These books are key classic references and remain as the top books for the subjects covered in the course and there are no up-to-date textbooks to substitute these books.

** UPRM library is subscribed to the IEEE Xplore database

(<http://www.uprm.edu/library/cre/listdbsp.php?l=1&ch=1>) which allows access to these journals and conference proceedings.

11. Law 51: The Comprehensive Educational Services Act for People with Disabilities:

States that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information, contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

12. Academic Integrity

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws. —

13. Certification 06-43 of the Academic Senate

"The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 06-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

14. Sexual Harassment: Certification 130-2014-2015 states:

Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.