

Syllabus

Technical Elective – Thermal Analysis of Electronic Systems

Fall Semester 2023

Instructor: Dr. Feng C. Lai (Office: 4 – 223)

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Office Hours: 9:00 - 11:00 Wednesday or by appointment

Course Description:

This course prepares students for interdisciplinary study and research in thermal management. It is intended to bring students' attention to the recent advancement in technology for electronics cooling. In this course, three subjects of thermodynamics, fluid mechanics, and heat transfer will be integrated to study the design of an electronic system. The objective of the course is to introduce students to the principles of thermal analysis required for design and operation of reliable electronic systems, and to lay the groundwork for further study in this area. Course topics will include the design of electronic packaging, fundamental principles of thermal analysis, and advanced cooling technologies. These principles are applied using a system perspective to analyze and understand how interactions between components would affect the performance of the entire system. At the end, students will master the necessary background science and mathematics to become proficient designers of electronic hardware.

Prerequisites: PHYS 0174, ENGR 0145, MATH 0290.

Textbook:

No required textbooks are assigned. Relevant reading materials will be provided/distributed electronically. Handouts are distributed in class and are necessary for understanding the course material.

In addition, the previous textbooks in heat transfer, fluid mechanics, and thermodynamics are very helpful, and they are referenced frequently throughout the semester. Some materials from these classes will be reviewed and expanded for the enrichment of learning experience.

References:

Yeh, L. T. and Chu, R. C., Thermal Management of Microelectronic Equipment, ASME Press, 2002.

Bar-Cohen, A., Encyclopedia of Thermal Packaging (Set 1: Thermal Packaging Techniques, 2012; Set 2: Thermal Packaging Tools, 2014; and Set 3: Thermal Packaging Applications, 2018), World Scientific Publishing Company.

Course Outcomes:

- To be able to understand the engineering design process and objectives of electronic packaging.
- To be able to understand the basis and criteria for the thermal management of electronic systems.
- To be able to prescribe the requirements of a design problem and show workable solutions that meet the requirements.

- To be able to model and analyze electronic components by integrating thermodynamics, fluid mechanics, and heat transfer.
- To be able to include economics analysis into the design of electronic systems.
- To be able to combine models of various electronic components to simulate the performance of a complete electronic system.
- To be able to optimize an electronic system to find the best set of operating condition or design parameters.

Course Outline:

- General Introduction
- Electronic Packaging
- Thermal Analysis Methods
- Advanced Cooling Technology
- Thermal Failure Analysis

Course Policies:

Make-up Policy: No make-up lecture/exam will be given if no prior arrangement (due to sickness or official business) has been made/approved.

Absences: Absence from class is strongly discouraged. Absence due to sickness or official business need to be approved before or at the occurrence of the event with proper document.

Other Policies: Late submission of assignment will not be accepted unless prior arrangement has been made.

Grade:

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| Homework/Quiz (8-10) | 10% |
| Project (2) | 40% |
| Mid-term Exams (2) | 30% |
| Final Exam | 20% |

Tentative Exam Schedule: (The actual dates will be announced in class)

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| Exam I | Oct. 12 th |
| Exam II | Nov. 23 rd |
| Final | Dec. 28 th |