SPRING 2023 ENME 808D THERMAL MANAGEMENT OF ELECTRONICS
Note: This Syllabus is based on EST Zone

Instructor: D. Agonafer
e-mail: agonafer@umd.edu
Office Hours: W: 4 PM – 6 PM
Glenn L. Martin Hall: Rm. 2145 or Via Zoom

Course Assistant: TBD

Course Assistants Office Hours via Zoom: TBD

Class: T TH 12:30 PM – 1:45 PM
Location: Bldg. Number 088
Room Number 0312
Instructor: Dr. Damena Agonafer

References (not required for purchase):
Fundamentals of Heat and Mass Transfer (Incropera & DeWitt)

Supplementary Material: Handouts including PowerPoint Presentations, Journal Articles, and URL links

Course Objectives:
What are we going to learn: (1) Fundamentals thermal challenges in electronic systems; (2) how to design and evaluate the thermal performance of electronic cooling systems; (3) what are the latest emerging techniques in electronics cooling and their implication.

Course Description:
As the demand for higher performance electronics continues its exponential growth, transistor density doubles every 18 to 24 months. Electronic devices with high transistor density generate heat and thus require thermal management to improve reliability and prevent premature failure. Demanding performance specifications result in increased package density, higher heat loads and novel thermal management technology. This course gives an overview of thermal management for micro/power electronics systems and helps engineers to develop a fundamental understanding of emerging thermal technologies. This course will include the following topics: Background of electronics packaging; thermal design of heat sinks; single phase and multiphase flow in thermal systems; Two-phase heat exchange devices for portable and high-powered electronic systems; Computational fluid dynamics for design of thermal systems. Prerequisites: Senior or graduate standing.

Reading assignments: Reading assignment based on journal articles will be assigned almost every week. The content of reading assignments will include material covered in lecture that week. The goal of reading assignments is to familiarize yourself with the course content both qualitatively

& quantitatively. Most reading assignments will be due Tuesday and must be uploaded to Canvas. A summary of the journal paper will be required to hand in. The grading rubric for reading assignments will be provided to you.

Computer Lab Assignments: Each week, we will go through an ICEPak Tutorial which will focus on modeling different thermal systems. Attendance for Lab is required. Lab assignments will typically be due the following Thursday. Late lab assignments will be deducted 25% within a 48-hour period and no credit given after 48 hours. The formatting of the lab report will be provided to you in Lecture.

Final Class Project: A final class project will be assigned towards the beginning of the semester. The goal of the final project is to identify develop a thermal model for a specific cooling technology. The reading assignments given in class will help you identify your topic. Topics must be approved by instructor. Students will progressively work on this project throughout the semester. More details on the format of the final class project will be provided in lecture.

Exams: There will be no semester of final exams for this course.

Course Rubric:
Reading Assignments 20%
Class Participation: 10%
Lab Assignments: 30%
Final Class Project (including report, presentation, and modeling demonstration): 40%

Attendance Policy: Class attendance is required. If you have any COVID-related symptoms and cannot attend class, please get tested immediately. You should contact the instructor and cc' the course assistant. To return to class, you must email the instructor a confirmation that you have been tested negative. Until you have been tested negative, please do not return to class.

Late Policy: Late homework assignments will be deducted 25% within a 48-hour period no credit given after 48 hours. Your lowest reading and lab assignment will be dropped.

Academic Integrity Policy: As adults training to become accredited (and potentially practicing) engineers, you are expected to adhere to professional behavior with regards to taking exams and completing assignments. For more information, please see the University of Maryland academic integrity policy: https://academiccatalog.umd.edu/undergraduate/registration-academic-requirements-regulations/academic-integrity-student-conduct-codes/

Course Structure: Tuesday Lecture: This lecture will include a review of course content which will complement your reading assignment. This lecture will also provide information on Thursday's lab.

Thursday Lab: A lab will take place almost every Thursday. You will go through an ICEPak tutorial which you will model a specific Thermal System. The labs must be turned in the following week.

Class Communication: In addition to Instructor and TA office hours, discussion forums in Canvas will be active to encourage interaction between students, instructor, and course assistants. These discussion forums will aid in addressing questions on lecture, homework, and lab assignments.

Date	Day	Topic	Type
1/26/23	Th	Introduction to thermal management of electronics and fundamental of heat transfer	Lecture
1/31/23	T	Microelectronics system, packaging, evolution, and thermal challenges	Lecture
2/2/23	Th	Icepak - Introduction and GUI, Model Building Part 1 (MO1 & MO2)	Lab
2/7/23	T	Conjugate Heat Transfer	Lecture
2/9/23	Th	Icepak - Conformal and Non-conformal Meshing (MO3 & MO6)	Lab
2/14/23	T	Guest Lecture	Lecture
2/16/23	Th	Icepak - Solving and Preprocessing (MO4) (Emphasize residuals) (Double Precision)	Lab
2/21/23	T	Conjugate Heat Transfer	Lecture
2/23/23	Th	Icepak - Model building part 2 and ECAD import (MO5)	Lab
2/28/23	T	Boiling & Condensation	Lecture
3/2/23	Th	Icepak - Transient Simulation and Macros (MO7)	Lab
3/7/23	T	Passive Cooling	Lecture
3/9/23	Th	Icepak - Space Claim and MCAD import (MO8)	Lab
3/14/23	T	Thermal Energy Storage	Lecture
3/16/23	Th	Icepak - Liquid Cooling (97-106)	Lab
3/21/23	T	**Spring Break**	Lecture
3/23/23	Th		Lab
3/28/23	T	Class Project Overview	Lecture
3/30/23	Th	Icepak - Heat Pipe Modeling (107-119)	Lab
4/4/23	T	Contact resistance and thermal spreading	Lecture
4/6/23	Th	Icepak - Multilevel Meshing and Parametrics (MO9)	Lab
4/11/23	T	Emerging technologies	Lecture
4/13/23	Th	Icepak - Minimizing thermal resistance (173-182)	Lab
4/18/23	T	Guest Lecture	Lecture
4/20/23	Th	Icepak - Ansys Workbench integration - thermo-mechanical simulation	Lab
4/25/23	T	Overview of Project Presentation/Report	Lecture
4/27/23	Th	Icepak - Datacenter Cooling (385-424)	Lab
5/2/23	T	Guest Lecture	Lecture
5/4/23	Th	Project Presentations	
5/9/23	T	Project Presentations	
5/11/23	Th	Project Presentations	