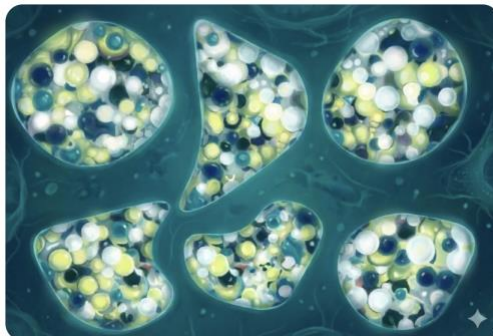


University of Notre Dame
AME 70671, Thermofluids Designs in Biomedicine (Spring 2026)

"All models are wrong, but some are useful."
- George E. P. Box (1976)



GENERAL INFORMATION

PROFESSOR INFORMATION

Instructor: Prof. Jingcheng Ma

Email: jma9@nd.edu

Office Hours: By appointment, 300B Cushing Hall of Engineering

CLASS TIME and LOCATION

Time: T/Th 11:00 am – 12:15 pm, 1/13 to 4/28

Location: DeBartolo Hall 334

TA INFORMATION

TA: TBD

COURSE INFORMATION

This graduate-level course focuses on learning and applying fundamentals of fluid mechanics and heat and mass transfer that are relevant to biology and biomedical devices. The course begins with introductory fluid mechanics and heat transfer, and then focuses on interfacial thermofluidic systems closely related to biomedical applications, including biosensors, wearable technologies, bioadhesives, cell and tissue culture systems, and thermal therapies. Specific interfacial topics include CFD, capillarity, wettability, functional coatings, noncovalent interactions, nucleation, and biofouling.

Credit: 3 graduate hours

Optional reference textbooks:

- 1) Bergman, Lavine, Incropera, and Dewitt, Fundamentals of Heat and Mass Transfer, Wiley, 7th Edition.
- 2) David Quere, Françoise Brochard-Wyart, and Pierre-Gilles de Gennes, Capillarity and Wetting Phenomena: Drops, Bubbles, Pearls, Waves, Springer, 2004th Edition.
- 3) Andrew L. Gerhart, John I. Hochstein, and Philip M. Gerhart, Munson, Young and Okiishi's Fundamentals of Fluid Mechanics, Wiley, 8th Edition.
- 4) Hans-Jürgen Butt, Michael Kappl, Surface and Interfacial Forces, Wiley, 2nd Edition.
- 5) Raymond H. W. Lam, Weiqiang Chen, Biomedical Devices: Materials, Design, and Manufacturing, Springer, AG2019

Prerequisite: N/A

TENTATIVE SCHEDULES

Week 1	01/13 (Overview), 01/15 (Fluid mechanics)
Week 2	01/20 (Fluid mechanics), 01/22 (CFD and COMSOL)

Week 3	01/27 (Dimensional analysis), 01/29 (Dimensional analysis)
Week 4	02/03 (Heat and mass transfer), 02/05 (Heat and mass transfer)
Week 5	02/10 (Surface fluids - droplets), 02/12 (Surface fluids - interfaces)
Week 6	02/24 (Surface fluids – molecular forces), 02/26 (Non-Newtonian fluids)
Week 7	03/03 (Surface engineering), 03/05 (Surface measurements)
Week 8	Midterm break
Week 9	03/17 (Phase change phenomena), 03/19 (Review for Midterm)
Week 10	03/24 (Midterm exam), 03/26 (Class canceled)
Week 11	03/31 (Literature - Functional Surfaces), 04/02 (Literature - Biomodulation)
Week 12	04/07 (Literature - Biosensors), 04/09 (Literature - Transportation)
Week 13	04/14 (Literature - Biophysics and Soft Matter), 04/16 (Literature - TBD)
Week 14	04/21 (Presentation), 04/23 (Presentation)
Week 15	04/28 (Class canceled)

GRADINGS

- 1) Homework (30%)
- 2) Midterm exam (10%)
- 3) Reading assignments (10%)
- 4) Paper critique (20%)
- 5) Proposal presentation (30%)

Grade and percentage equivalent:

A: 80% - 100%

A-: 70% - 80%

B+: < 70%

OTHER POLICIES

Generative AI Policy: You are allowed and encouraged to use generative AI such as ChatGPT for all the assignments, but not the exams.

Homework policies: Homework turned in within 48 hours after the deadline will be given 50% score. After 48 hours past the deadline, 0% score will be given.

Policy on conflicts or emergencies:

(1) For time conflicts with other events (e.g. another scheduled exam), or an official University of Notre Dame activity, please show official documentation about the conflict at least one week before the homework/quiz/exam due date. The due date will be extended if the excuses are legitimate.

(2) If you will not be able to make it to the exam due to serious illness or other emergent personal crisis that are not described in (1), please send an email to the instructor (jma9@nd.edu) at your earliest convenience, and submit a statement from the professionals that are authorized to evaluate your situation (e.g. doctors,

police officers). The statement needs to clearly explain that you are not physically capable of attending exams on time. The due date will be extended if the excuses are legitimate.

Honor code: The University's Honor Code reminds our community of our shared purpose both within the institute of academia and as members of a broader humanity; the statement also outlines policy violation procedures. The Honor Code will be strictly applied as described in The Academic Code of Honor Handbook. Students will not give or receive aid on exams. This includes, but is not limited to, viewing the exams of others, sharing answers with others, and using books or notes while taking the exam. *Plagiarism is unacceptable* and will result in a zero grade for all persons involved, and will result in serious academic repercussions.

Disability and accommodation: It is the policy and practice of The University of Notre Dame to provide reasonable accommodations for students with properly documented disabilities. Students who have questions about Sara Bea Disability Services or who have, or think they may have, a disability are invited to contact Sara Bea Disability Services for a confidential discussion in the Sara Bea Center for Students with Disabilities or by phone at 574-631-7157. Additional information about Sara Bea Disability Services and the process for requesting accommodations can be found at sarabeadisabilityservices.nd.edu.

Privacy practices in this course: Course materials (lecture notes, slides, assignments, problem sets, etc.) are for use in this course only. You may not upload them to external sites, share with students outside of this course, or post them for public commentary without my written permission.