

MEAM 454 HEAT and MASS TRANSFER

SYLLABUS

Text: " Fundamentals of Heat Mass Transfer" by Incropera and DeWitt, 6th edition.

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COURSE CONTENT

The content of the course and the approximate class time devoted to each topic is outlined below.

<u>Chapter</u>	<u>Topics</u>	<u>Class Periods</u>
1, 2	Introduction	3
3	One –dimensional heat conduction	3
4	Two –dimensional heat conduction	4
5	Transient heat conduction	5
6	Principles of convection heat and mass transfer	3
7, 8	Equations of forced convection	5
9	Equations of free convection	5
12	Principles of radiation heat transfer	3
13	Radiation exchange between surfaces	5
11	Heat exchanger analysis	4
14	Mass transfer	5

INTENDED COURSE OUTCOMES

A student achieving a passing grade in this course will be able to do basic calculations involving heat and mass transfer as is typical for a mechanical engineer. This includes conduction, convection and radiation heat transfer as well as heat exchanger design.

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The students will also be required to work as part of a team on an open-ended design project. This project will involve the application of concepts learned in the ME 454.

COURSE OBJECTIVES

1. Students will understand the basic concepts of conduction, convection and radiation heat transfer. (1b)
2. Students will understand how to formulate and be able to solve one and two dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions. (1a, 1c, 2e)
3. Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer. (1c)
4. Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients. (1c, 2e)
5. Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation. (2d, 3b)
6. Students will be able to evaluate radiation view factors using tables and the view factor relationships. (2b, 2e)

Items in parenthesis refer to the affected Program outcomes (see attachment).

COURSE GRADES

The grades for the course will be determined as follows:

Exams	50%
Final exam	30%
Homework & design project	20%

There will be an exam problem given about every two weeks and they usually will be scheduled on Wednesdays. **Individual makeup exams will be given for missed exams at the discretion of the instructor and only for an excused absence.**

The final exam will be given at the time designated by the University final test schedule. All students must take the final exam at this time.

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Homework assignments will be given daily and are considered due the following class period. Homework problems may occasionally be collected at the beginning of class and may be graded. No late papers will be accepted. Homework must be in acceptable engineering form including labeled drawings of the system being considered or it will not be graded.

Final course grades will assigned according to the following scale.

- A 90% or greater
- B 80% to less than 90%
- C 70% to less than 80%
- D 60% to less than 70%
- F less than 60%

STUDENTS WITH SPECIAL NEEDS

Students who have any disability that might affect their performance in this class are encouraged to speak with the instructor early in the semester.

All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct (<http://www.ndsu.nodak.edu/policy.335.htm>)

Department of Mechanical Engineering and Applied Mechanics, North Dakota State University

Mission

To educate undergraduate and graduate students in the fundamentals of the discipline, and prepare graduates (BS, MS, or PhD) to effectively function in society in the field of their choice while also having the learning skills to adapt to evolving personal and professional goals.

Program Educational Objectives & Outcomes

Objective 1: **To provide our students with a fundamental understanding of the engineering sciences in the areas relevant to the field of Mechanical Engineering .**

- Outcomes:*
- a) Graduates must have the ability to apply knowledge of mathematics and science to solve engineering problems.
 - b) Graduates must have the ability to identify, formulate, and solve fundamental engineering problems.

- c) Graduates must have the ability to identify a suitable model for a physical system, and apply principles of mechanics, thermodynamics, fluid mechanics, and materials to obtain a solution that satisfies the constraints.

Objective 2: To provide our students with the ability to develop the skills and apply the knowledge and tools relevant to the field of Mechanical Engineering.

- Outcomes:*
- a) Graduates must have the ability to design and conduct experiments as well as to analyze and interpret data.
 - b) Graduates must have the ability to design a system, component, or process to meet desired needs.
 - c) Graduates must recognize the need for, and possess an ability to engage in, life-long learning.
 - d) Graduates must have the ability to use techniques, skills, and modern engineering tools necessary for engineering practice.
 - e) Graduates must be able to analyze a physical system, and create and validate models based on engineering and mathematical principles that correctly represent such systems and reflect current industry practices.

Objective 3: To provide our students with the team-working skills and communications skills required for effectively interacting with people of varying technical background.

- Outcomes:*
- a) Graduates must have the ability to function on multidisciplinary teams.
 - b) Graduates must have the ability to communicate effectively.

Objective 4: To provide our students with a broad view of the context in which their designs will be implemented and the corresponding impact on society.

- Outcomes:*
- a) Graduates must have an understanding of professional and ethical responsibility.
 - b) Graduates must possess the broad education necessary to understand the impact of engineering solutions in a global/societal context.
 - c) Graduates must possess knowledge of contemporary issues.