WEST VIRGINIA UNIVERSITY INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
COURSE POLICY & SYLLABUS

Spring 2016

COURSE:	MAE 423 – Heat and Mass Transfer MAE 419 – Heat and Mass Transfer Lab
PREREQUISITES:	MAE 320 – Thermodynamics, MAE 321 – Applied Thermodynamics (co-requisite)
WEB PAGE:	community.wvu.edu/~bpbettig/MAE423 Labs submitted via eCampus
TEXT:	F. Kreith, R.M. Manglik, M.S. Bohn, *Principles of Heat Transfer*, 7th Edition, Cengage Learning, 2011
INSTRUCTOR:	Dr. Bernhard Bettig Office: E-303 Phone: 304-442-3289 Email: bpbettig@mail.wvu.edu Office Hours: M 10-12; 1-3; T 2-5; WF 1-2; R 11-12; and by appointment

A. Course Objectives

This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail. As well, to gain experience in designing experiments for thermal systems, the design, fabrication, and experimentation of a thin film heat flux gage will be attempted as part of laboratory requirements.

B. Learning Outcomes

Upon successful completion of this course, the student will be able to:

1. Understand the basic laws of heat transfer.
2. Account for the consequence of heat transfer in thermal analyses of engineering systems.
3. Analyze problems involving steady state heat conduction in simple geometries.
4. Develop solutions for transient heat conduction in simple geometries.
5. Obtain numerical solutions for conduction and radiation heat transfer problems.
6. Understand the fundamentals of convective heat transfer process.
7. Evaluate heat transfer coefficients for natural convection.
8. Evaluate heat transfer coefficients for forced convection inside ducts.
9. Evaluate heat transfer coefficients for forced convection over exterior surfaces.
10. Analyze heat exchanger performance by using the method of log mean temperature difference.
11. Analyze heat exchanger performance by using the method of heat exchanger effectiveness.
12. Calculate radiation heat transfer between black body surfaces.
13. Calculate radiation heat exchange between gray body surfaces.

This course contributes to the assessment of the following program (student) outcomes:

e. an ability to identify, formulate, and solve engineering problems

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

C. Assessment

1. ATTENDANCE

Lecture and laboratory attendance is important for maximizing the learning benefits of this course and therefore regular attendance is expected. Learning is motivated through active discussion, demonstration and practice of the topics being studied. You are responsible for all completed work, schedule adjustments and assigned work addressed during class. Please inform your instructor if you are unable to attend any scheduled class session, and obtain notes from any missed lecture(s). It is your responsibility to make arrangements for any planned or unplanned absences (i.e. interviews, illnesses, personal emergencies, etc.).

2. HOMEWORK

Homework is the best way to make clear the concepts taught in class. Trying to solve a problem forces working out and understanding all of the related details. In this course, homework is intended to be a worry-free endeavor. You are encouraged to try to solve problems the way you think they should be solved. Feel free to work with your friends and consult any resources that are available to you. Don't worry about making mistakes. The homework will be graded purely on effort. Homework is due the class period after it has been assigned unless another due date is announced. Circumstances beyond your control (i.e. illness, computer system failure, weather, acts of nature, etc.) will be addressed as required. After the homework is returned, detailed solutions will be made available to you. Don't squander the opportunity to learn by doing homework.

The purpose of homework in this course is also to develop skills in clearly, logically, and completely communicating problem-solving methodologies. Therefore:

- Each problem must have sections: "Given," "Find," "Assumptions," and "Solution." Sketches must be employed to illustrate the system in question, whenever the spatial relationships of quantities are not obvious.
- The units must be clear for every numeric value. Real values must have at least three significant digits for intermediate results to avoid excessive error accumulation due to truncation. Final answers must have significant digits that reflect the known precision of the solution.
- All computations must first show equations symbolically and then with numeric values, without any rearrangement of variables.
- Submitted work must be neat. Use a ruler and compass for diagrams; underline or put boxes around answers.
- Convince me you have the correct answer!

3. LABORATORY REPORTS

Reports should be as short as possible while providing all of the information required by the lab manual. All sentences MUST be phrased in the third person. Use the template provided in the course web page. (No need to be creative. Just fill in the blanks.) Lab reports are due on the day of the next lab session. Late work will be charged a 10% penalty for ***each*** day late - weekend days do count. Circumstances beyond your control (i.e. illness, computer system failure, weather, acts of nature, etc.) will be addressed as required. Lab reports must be submitted electronically via eCampus.

4. EXAMS

Exams will be graded on the basis of appropriateness of method of approach, correctness of details of solution, and accuracy of numerical results.

Two mid-term exams will be given during the semester and a final exam will be given during exam week. All exams will be closed-book, closed-notes, but self-written formula sheet(s) will be allowed. (The maximum number of pages will be stated in class.) The formula sheet(s) may contain figures, equations, formulas, procedures, etc.; but they may not contain any numerical solutions or worked examples. The mid-terms will be in-class during the regular lecture time. The final exam will be given according to the school schedule.

5. GRADING

Your final grade will be computed based on the deliverables and grading scale in the following tables.

Course Deliverables	
Homework	5
Lab Reports (4 @ 5 marks each)	20
Mid-Term Exams (25 marks each)	50
Final Exam	25
Course Total	100

Grading Scale	
A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	< 60%

D. Syllabus

The course will tentatively follow the outline in the following table.

Week	**Lecture Topics**	**Text Reading**	**Homework**
1 (1/11)	Basic modes of heat transfer	1.1 – 1.5	1.1, 4, 16, 17, 25
2 (1/18)	Combined heat transfer systems	1.6 – 1.7	1.3, 31, 32, 37
3 (1/25)	Heat transfer and energy conservation	1.8	1.45, 1.48, 1.61
4 (2/1)	Steady heat conduction in simple geometries	2.1 – 2.3	2.4, 20, 21
5 (2/8)	Extended surfaces **Midterm Exam 1**	2.4	2.25, 29
6 (2/15)	Multi-dimensional steady conduction	2.5	2.31, 33
7 (2/22)	Transient heat conduction	2.6 – 2.8	2.54, 56
8 (2/29)	Numerical solutions of steady conduction	3.1 – 3.3	Computer prob.

9 (3/7)	Numerical solutions of unsteady conduction Analysis of convection heat transfer	3.4 – 3.6 4.1, 4.2, 4.4 – 4.8, 4.12, 4.14	4.2, 3, 6, 8, 25, 31
10 (3/14)	Natural convection **Midterm Exam 2**	5.1 – 5.3, 5.5, 5.7	5.1, 4, 5, 7, 10
11 (3/28)	Forced convection inside tubes and ducts	6.1, 6.3, 6.5, 6.7	
12 (4/4)	Forced convection over exterior surfaces	7.1, 7.2, 7.4 – 7.6	
13 (4/11)	Heat exchangers	8.1 – 8.6	
14 (4/18)	Radiation processes and radiation properties	9.1 – 9.3	
15 (4/25)	Radiation heat exchange between surfaces	9.4 – 9.6, 9.9 – 9.10	
16	Final Exam (Tuesday, May 3, 8:00 am)		

* content is time-permitting

Inclusivity

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (304.981.6210). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.