1: Course Number and Name

a. **MENG 3411**: Heat Transfer, Spring 2020
b. Section 010, MWF 9:00 – 9:50 pm

2: Credits and Contact Hours

a. **Credits**: 4
b. **Contact Hours**: 3 hours/week (Classroom) 3/hours/week (Lab)

3: Instructor Information

a. **Course Coordinator**: Manuel Garcia
b. **Instructors**:
   i. Manuel García, 325-486-5515, manuel.garcia@angelo.edu. Office: VIN 274. For office hours see faculty homepage.

4: Required Course Materials

Bergman Fundamentals of Heat & Mass Transfer 8th Edition. WileyPLUS access.

5: Technology Requirements

To successfully complete this course, you need

a. WileyPLUS access
b. **Squarecap** is a web-based classroom response application that your instructor will be using during your course for in-class Q&A and verifying your attendance. Use any Wi-Fi capable device, visit http://www.squarecap.com and login with your Angelo State account. Subscription required.
c. Python and Jupiter Notebooks. Projects are solved using Python in a Jupyter Notebook. You can access two ways:

   Via the VDI Server at Angelo State: http://view.angelo.edu

   Local installation in your personal computer: Anaconda Python
d. Online access to the classes via GoogleMeet: https://meet.google.com/tkr-uwye-pcf

6: Specific Course Information

a. **Catalog Description:** Fundamentals of heat transfer; conduction, convection, and radiation. Steady-state and transient conduction analysis. Lumped capacitance. Convection heat transfer for laminar and turbulent flow regimes. Radiation heat transfer between solid bodies.
c. **Prerequisites**: ENGR 2302 and MATH 3324
d. **Required or elective**: Required (Engineering Principles)

7: Specific Goals for the Course

a. Course Learning Outcomes:

1. Modify the heat diffusion equation in solving heat transfer problems in cartesian, cylindrical, and spherical coordinate systems (SO1)
2. Solve one-dimensional steady-state and transient heat conduction problems (SO1)

3. Solve multi-dimensional steady-state and transient heat conduction problems (SO1)
4. Conduct dimensional analysis to identify dimensionless parameters in HT problems
5. Solve forced convection problems involving internal and external flows (SO1)
6. Solve free convection problems (SO1)
7. Solve radiation heat transfer exchange problems between surfaces (SO1)
8. Apply heat transfer principles to fin design and/or the design of heat exchanger device
9. Being knowledgeable of one or contemporary issues involving heat transfer by doing research projects (SO2, SO3)
10. Use computer software in numerical analysis of heat transfer problems (SO1)
11. Perform experiments concerned with heat transfer (SO1, SO6).
12. Record, process and display experimental data for the purposes of comparison and trend analysis (SO1, SO3, SO6).
13. Determine appropriate report formatting for effective communication of experimental results (SO3).

b. Course Learning Outcome Mapping to ABET Criterion 3 Student Outcomes:

Table 1: Course Learning Outcomes mapped to ABET Student Outcomes

ABET Student Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Solve Problems	X	X	X	X	X	X	X	X		X	X	X	
2. Design								X	X				
3. Communication									X				
4. Ethics & Professionalism													
5. Teamwork									X				
6. Experimentation											X	X	
7. Acquire New Knowledge													

8: Topics Covered

1. Derivation of transient multi-dimensional heat equation
2. Analytical solutions to steady-state one-dimensional heat conduction
3. Dimensional analysis
4. Solutions to steady-state two-dimensional heat conduction problems
5. Solutions to transient heat conduction problems
6. Heat transfer by forced convection
7. Heat transfer by free convection
8. Heat exchangers
9. Radiation exchange between surfaces
10. Numerical methods for heat conduction
11. Measurement of fluid and thermal properties of solids, liquids and gases.
12. Design projects and formal reports

9: Course Delivery and Communications

9.1: Delivery Method(s)

This is a face-to-face course with learning resources and supplemental materials posted in Blackboard. Accommodations will be made for students who are in quarantine or isolation and are unable to attend. Exams will be face to face. Exams will be face to face.

9.2: Communications

You may communicate with the instructor via Blackboard, email, phone, or GroupMe text. Faculty will respond to these within 24 hours during working hours Monday through Friday. Weekend messages may not be returned until Monday.

Written communication via email: All private communication will be done exclusively through your ASU email address. Check frequently for announcements and policy changes. In your emails to faculty, include the course name and section number in your subject line.

Office hours or advising may be arranged with the assistance of Collaborate, or Google Meet platforms

10: Professionalism

Professional engineering standards apply in this class. You are expected to demonstrate a behavior consistent with the conduct of an individual practicing in the engineering profession. You are expected to: (1) come prepared for class; (2) respect faculty and peers; (3) demonstrate responsibility and accountability for your own actions; (4) demonstrate sensitivity and appreciation for diverse cultures, backgrounds, and life experiences; (5) offer and accept constructive criticism in a productive manner; (6) demonstrate an attitude that fosters professional behavior among peers and faculty; (7) be punctual to class meetings; (8) maintain a good work ethic and integrity; and (9) recognize the classroom as a professional workplace.

11: Graded Material

11.1: Class Attendance, Participation, Timeliness and Teamwork

The number one complaint of engineering clients is the timeliness of deliverables (reports, drawings, specifications, etc.). As a professional engineer you will be expected to arrive at scheduled meetings on time and prepared. Late proposals are not generally accepted. Late specifications or drawings may cost the engineer a monetary penalty. Professional engineering standards apply in this course.

You are expected to meet every class meeting on time and prepared. Attendance will be taken with Squarecap. Should you find it necessary to miss a class for any reason, you are expected to notify your instructor as early as the absence is known—preferably before the absence. It's important that you communicate clearly your instructors.

Your online assignments will be due at the time specified on WileyPlus. Any assignments submitted in hard copy are due at the beginning of class on the due date. Your instructor may assess penalties for late work.

11.2: Reading Assignments and Homework

You will be given reading and homework assignments nearly every lesson. Reading assignments will come from the assigned textbooks or other materials provided or available via the web. The homework assignments will consist of questions to be answered during your reading and preparation for class. Reading and homework assignments will be distributed via the Blackboard and WileyPlus.

11.3: Quizzes

Instructors will use a Student Response System SRS for in class questions and interaction[1]. The SRS questions will be unannounced and unscheduled. They are intended to quickly determine student comprehension, provide instant feedback, and adapt the pedagogy during class. They encourage engagement and are graded instantly. The SRS used in this course is Squarecap.

11.4: Course Exercises

There will be in-class exercises in this course. Participation in exercises is expected from all students. Zero points will be awarded for missed exercises. These exercises cannot be made up.

11.5: Exams

Make-up exams will only be given for extenuating circumstances, unless prior arrangements with the instructor are agreed upon. Proof, such as a doctor's note or other official document, may be required for unexcused absences during an exam. Approval from the Disability Services office is needed if you are under quarantine due to a close contact or sickness. Please complete the COVID-19 Wellness Screening daily.

Exams will not be open textbook or notes, but a formula sheet will be provided. Details will be discussed closer to the exam time.

11.6: Term Project Reports

There will be three projects assigned in this class. The projects can be completed by group effort (2 people maximum). These reports must be completed *clearly* and *legibly* for full credit. The reports will be prepared using a word processor (e.g., Word, Pages, LaTeX). Tables and graphs must also be completed using a software program (e.g. Python). Any sloppy report that is not formatted correctly will receive reduced credit down to zero credit.

A technical report must include the following sections:

- A *cover page* that states the title of the report, the author(s) of the report, the course number, the semester, and any other organizational information;
- An *abstract* or *executive summary* that presents a short summary and motivation of the entire report (between 100 to 200 words);
- An *introduction* that provides the purpose, technical background, motivation for the report, and a description of theoretical considerations and an explanation of why those theories and equations are included in the report;
- A detailed *procedure* that explains the type of data that is being considered, how various probabilistic models were applied to the data set, and any other applied theoretical considerations. This *procedure* should not be a bulleted list of tasks that done – instead, this *procedure* must explain what you *did* using full and complete sentences. Finally, equations are part of the sentences and paragraphs and help explain the procedure. A list of equations is not self-explanatory and should be avoided.
- A *results* section that includes necessary sample calculations, and graphs, and tables containing major results. Tables/graphs with intermediate calculations, researched data or long computational results should go in the appendix section;

- A *discussion* that specifically answers the assigned questions given by your instructor where the discussion is supported by theory described in your *introduction* and supported by data presented in your *results* section;
- A list of *conclusions* that is drawn from your *results* and *discussion*. Your conclusions must clearly reiterate thoughtful statements and not simply re-state facts; and
- A list of bibliographic references cited in the report. Do not include a referenced not cited in the body of the text
- An *appendix* that includes additional tables, followed by figures, followed by sample calculations, all listed in numerical order. Numerical order is dictated by the order in which the table, figure, or sample calculation is mentioned in the main body of the technical report. Do not repeat tables or graphs both in the body of text and appendices. Do not include a figures or tables not referenced in the body of the text. Do not include list of equations in the appendix.
- **Do not include** handwritten material

In general, your reports must be organized according to this format, sections must be clearly labeled and contain the correct content, grammar and sentence structure must be correct, the overall appearance must be neat and professionally assembled, and the technical content must be correct.

11.7: Grades: Weighting and Letter Grades

The weighting system shown in Table 2 will be used in determining final grade for the course

Table 2: Grade Weighting

Item	Percent
Homework	12%
Quizzes	7%
Laboratories	15%
Project	15%
Exams	36%
Final Exam	15%
Total	100%

The instructor will determine letter grades for the course using his professional judgment, and the following standards as described in the University Catalog:

A = excellent work B = good work C = average work D = poor work F = failing work

11.8: Incomplete Grade Policy

It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 Grading Procedures[2] for more information.

12: Classroom and University Policies and Student Support

All students are required to follow the policies and procedures presented in the Angelo State University Student Handbook[3] and Angelo State University Catalog[4].

12.1: Accommodations for Students with Disabilities

ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA) and subsequent legislation.

Student Disability Services is located in the Office of Student Affairs, and is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability. It is the student's responsibility to initiate such a request by contacting an employee of the Office of Student Affairs, in the Houston Harte University Center, Room 112, or contacting the department via email at ADA@angelo.edu. For more information about the application process and requirements, visit the Student Disability Services website.[5] The employee charged with the responsibility of reviewing and authorizing accommodation requests is:

Dr. Dallas Swafford
Director of Student Disability Services
Office of Student Affairs
325-942-2047
dallas.swafford@angelo.edu
Houston Harte University Center, Room 112

12.2: Title IX at Angelo State University

Angelo State University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from sex discrimination of any kind. In accordance with Title VII, Title IX, the Violence Against Women Act (VAWA), the Campus Sexual Violence Elimination Act (SaVE), and other federal and state laws, the University prohibits discrimination based on sex, which includes pregnancy, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination and unwelcome behavior of a sexual nature. The term includes sexual harassment, nonconsensual sexual contact, nonconsensual sexual intercourse, sexual assault, sexual exploitation, stalking, public indecency, interpersonal violence (domestic violence or dating violence), sexual violence, and any other misconduct based on sex.

You are encouraged to report any incidents involving sexual misconduct to the Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator, Michelle Miller, J.D. You may submit reports in the following manner:

Online: Incident Reporting Form[6]
Face to Face: Mayer Administration Building, Room 210
Phone: 325-942-2022
Email: michelle.miller@angelo.edu

Note, as a faculty member at Angelo State, I am a mandatory reporter and must report incidents involving sexual misconduct to the Title IX Coordinator. Should you wish to speak to someone in confidence about an issue, you may contact the University Counseling Center (325-942-2371), the 24-Hour Crisis Helpline (325-486-6345), or the University Health Clinic (325-942-2171).

For more information about resources related to sexual misconduct, Title IX, or Angelo State's policy please visit the Title IX website.[7]

12.3: Student Absence for Observance of Religious Holy Days

A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day[8] for more information.

12.4: Information About COVID-19

Please refer to ASU's COVID-19 (Coronavirus) Updates[9] web page for current information about campus guidelines and safety standards as they relate to the COVID-19 pandemic.

12.5: Student Conduct Policies

12.5.1: Academic Integrity

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject of disciplinary action and possible expulsion from ASU.

12.5.2: Plagiarism

Plagiarism is a serious topic covered in ASU's Academic Integrity policy[10] in the Student Handbook. Plagiarism is the action or practice of taking someone else's work, idea, etc., and passing it off as one's own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality via Turnitin or SafeAssign. Resources to help you understand this policy better are available at the ASU Writing Center[11].

12.5.3: Copyright Policy

Students officially enrolled in this course should make only one printed copy of the given articles and/or chapters. You are expressly prohibited from distributing or reproducing any portion of course readings in printed or electronic form without written permission from the copyright holders or publishers.

13: Course Outline

The course outline is presented in the table next page. Detailed reading and homework assignments along with updates to this schedule will be provided via Bb. The following schedule may be modified as the semester progresses.

Table 3: Course Lesson Outline

Week	Date	Lesson	Topic	Reading	Laboratory
1	Jan 19	1	Introduction to Heat Transfer	1.1	
	21	2	Heat Transfer modes	1.2	
	24	3	Energy Conservation	1.3	
2	26	4	Conduction rate Equation	2.1-2.2	
	28	5	Diffusion Equation	2.3-2.4	
	31	6	1D conduction: Plane wall	3.1.1	Conduction 1
3	Feb 2	7	1D conduction: Composite wall	3.1.3	
	4	8	1D conduction: Radial systems	3.3	
	7	9	1D conduction: Energy generation	3.5	Conduction 2
4	9	10	Extended surfaces 1	3.6	
	11	11	Extended Surfaces 2	3.6	
	14	12	Extended Surfaces 3	3.6	Ext surfaces
5	16	13	Review		
	18	14	Exam 1		
	21	15	2D steady conduction numerical	4	
6	23	16	Shape factor	4	
	25	17	2D steady conduction numerical	4	
	28	18	2D steady conduction numerical	4	
7	Mar 2	19	2D steady conduction numerical	4	
	4	20	2D steady conduction numerical	4	
	7	21	Transient conduction, Lumped capacitance	5.1,2	
8	9	22	Spatial Effects	5.4 - 5.6	
	11	23	Semi-infinite body	5.7	
	14	24	Semi-infinite body	5.7	Transient Cond
SB	16				
	18				
	21				
10	23	25	Convection Boundary Layer	6.1	
	25	26	Convection Boundary Layer		
	28	27	Local and Average Boundary Layer.	6.2	
11	30	28	Laminar and Turbulent Flow	6.3	
	April 1		Exam 2		
	4	29	External convection	7.1	Rev Project
12	6	30	External convection	7.2	

	8	31	Internal Flow. Hydrodynamic consider	8.1	
	11	32	Internal Flow. Thermal considerations	8.2	
13	13	33	Internal Flow. Energy balance	8.3	Convection
	15	34	Internal flow (laminar, mixed, turbulent)	8.4	
	18	35	Exam 3		
14	20	36	Thermal radiation	12.1	
	22	37	Thermal radiation	12.4	
	25	38	Thermal radiation	12.5	Radiation
15	27	39	Thermal radiation Exchange	13.1	
	29	40	Thermal radiation Exchange	13.2	
	May 2		Thermal radiation Exchange	13.3	Final Project
16	4		Final Exam		

14: End Notes

[1] Kaleta, Robert, and Tanya Joosten. "Student response systems." Research Bulletin 10.1 (2007): 1-12. PDF Link.
[2] https://www.angelo.edu/content/files/14197-op-1011-grading-procedures
[3] http://www.angelo.edu/student-handbook/
[4] http://www.angelo.edu/catalogs/
[5] https://www.angelo.edu/current-students/disability-services/
[6] https://www.angelo.edu/incident-form
[7] https://www.angelo.edu/title-ix
[8] http://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of
[9] https://www.angelo.edu/covid-19/
[10] http://www.angelo.edu/student-handbook/community-policies/academic-integrity.php
[11] http://www.angelo.edu/dept/writing_center/academic_honesty.php