BAEN 320, ENGINEERING THERMODYNAMICS
SYLLABUS, SPRING 2019

Instructor	E-mail Address	Telephone	Office Location	Office Hours
Dr. Maria D. King	mdking@tamu.edu	845-2251	Scoates 301C	Open door police, schedule appointment
Teaching Assistant	**E-mail Address**		**Office Location**	**Office Hours**
Alexander Zuniga	alexzuniga@tamu.edu		Scoates 325	Open door police

Class Times and Location:

Section 201, 500, 501: MW 3.00-3:50 p.m. Scoates 317 and F 1:50 - 3:40 p.m. Scoates 214 (Computer lab)
Section 502, 503: MW 3.00-3:50 p.m. Scoates 317 and F 8.10 - 10:00 p.m. Scoates 214 (Computer lab)

Course Web Site:

http://eCampus.tamu.edu/

Text:

Selected chapters from *Thermodynamics: an Engineering Approach*, Yunas A. Çengel and Michael A. Boles, 8th Edition, McGraw-Hill, New York, 2014

Software:

Engineering Equation Solver, F-Chart Software, Middleton, WI
Available from SELL (Software Evaluation Licensing Lab) in Teague 1105.

Prerequisite: MEEN 221 **Corequisite:** MATH 251

Course Description:

First and second laws of thermodynamics; properties of pure substances; closed and open systems of various types; applications to steady-flow and non-flow processes; power and refrigeration cycles; psychrometrics.

Course Goal:

To help each student develop his/her problem-solving ability and gain insight into the process of problem-solving, with emphasis on thermodynamics. Specifically, this course is designed to help students learn to

- apply conservation principles (mass and energy) to evaluate the performance of simple engineering systems and cycles,
- evaluate thermodynamic properties of simple homogeneous substances,
- analyze processes and cycles using the second law of thermodynamics to determine maximum efficiency and performance,
- discuss the physical relevance of the numerical values for the solutions to specific engineering problems and the physical relevance of the problems in general, and
- critically evaluate the validity of the numerical solutions for specific engineering problems.

Learning Outcomes

At the completion of this course, students should be able to

1. find values of thermodynamic properties in tables;
   draw thermodynamic processes on pressure-temperature, pressure-volume, or temperature-volume diagrams;

use compressibility charts;
calculate expansion or compression work in a closed system;
use conservation of mass to determine the change in mass of a system;
apply conservation of energy to closed or open systems to determine heat transfer, work, or system property changes;
analyze first law performance of simple engineering devices (e.g., valves, turbines, boilers);
determine maximum performance of cycles using the Carnot cycle;
identify sources of entropy generation in a system;
calculate work for isentropic processes;
calculate isentropic efficiencies for steady-flow engineering devices;
identify work and heat transfer processes in any arbitrary cycle;
estimate work and efficiency for various power cycles;
determine properties of moist air;
analyze air-conditioning processes;
use Engineering Equation Solver (EES) to model performance of thermodynamic cycles.

COURSE GRADING AND FORMAT

Grading:

Mid-term Exams (2)	50 %	A	90 - 100 %
Final exam	25 %	B	80 - 89 %
Quizzes/Homework	25 %	C	70 - 79 %
		D	60 - 69 %
		F	<60 %

Format:

This course will include traditional lectures, discussion, and problem-solving activities. It is essential to prepare for class by reading assigned materials and working the related problems, to attend daily, and to participate in class discussions and activities to do well in the course.

Exams:

Dates for all exams are on the course schedule. These may include both problems to solve and short answer/multiple choice questions. Exams will be based on individual work and will be ***closed book*** and ***closed notes***. A Property Tables and Charts booklet and a sheet of equations will be provided for each exam. The final exam will be comprehensive. A help-session will be held by the TA on the exam week.

Make-up exams will be given only for those having a university excused absence (see Student Rules). Make-up exams will be scheduled in consultation with the instructor.

Homework and Quizzes:

Problems related to each course topic are listed on the tentative course schedule. These are for your guidance in studying for the course and will not be graded. Solutions to the problems will be posted approximately a week after the topic has been covered. Unannounced quizzes covering recently covered topics and related problems will be given periodically. No make-up quizzes will be given. For any quiz missed due to a university excused absence, that quiz will not be included in calculating the final quiz grade. In addition, several homework assignments using EES will be made during the semester which will be graded. No late homework will be accepted.

POLICIES, ETC.

Copyright Material:

All materials provided by the instructor for this course are copyrighted. This means all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, laboratory problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to sell or give them to others unless the instructor expressly grants permission.

Academic Integrity:

Academic Integrity Statement and Policy - "An Aggie does not lie, cheat or steal, or tolerate those who do." Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept the responsibility for learning and to follow the philosophy and rules of the Honor System (http://aggiehonor.tamu.edu).

Students with Disabilities

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit http://disability.tamu.edu/. Also, as a courtesy, please advise the instructor as soon as possible if you need accommodations for a disability.

Absences

You must notify the instructor in advance if possible of any absence by sending an email stating the date and reason for the absence. If you are absent for up to two class periods because of illness or injury, an email message stating the reason for absence will be sufficient. If you are absent from more classes because of illness or injury, verification of a visit to a health care professional may be required. See Student Rule 7.1 (https://student-rules.tamu.edu/rule07/) regarding excused absences.

BAEN 320, ENGINEERING THERMODYNAMICS
CLASS SCHEDULE (tentative)

Assignments are from *Thermodynamics: an Engineering Approach* by Cengel and Boles (8th Ed.).

Week	Date	Subject	Read	Related Problems (8th Ed)
1	Jan. 14 16 18	Introduction, units, systems, properties, processes Temperature, pressure, problem solving, and manometer Problems	1-1 – 1-7 1-8 – 1-12	Ch. 1: 11E, 12, 17 Ch. 1: 37E, 50, 51, 64, 75
2	23 25	Energy, heat and work First law, energy conversion efficiency Properties, PvT behavior, phase diagrams	2-1 – 2-5 2-6 – 2-8 3-1 – 3-4	Ch. 2: 16, 28E, 36 Ch. 2: 42E, 44, 59E, 82
3	28 30 Feb. 1	Property tables Ideal and real gases Properties Problems	3-5 3-6 – 3-8	Ch. 3: 23, 27E, 43, 62 Ch. 3: 69E, 74E, 82, 86E
4	4 6 8	Boundary work, closed system energy balance Specific heats, *U*, *H* (ideal gases) Introduction to EES	4-1 – 4-2 4-3 – 4-4 notes	Ch. 4: 6, 9, 12, 31, 41 Ch. 4: 55, 64, 72, 76
5	11 13 15	Specific heats, *U*, *H* (solids and liquids) Conservation of mass, flow work, energy transport Exam review (through chapter 5-2); Problems	4-5 5-1 – 5-2	Ch. 4: 82, 85, 87 Ch. 5: 7, 10, 22E, 21
6	18 20 22	Steady-flow systems: nozzles, diffusers Valves, turbines, compressors **EXAM 1** (through Chapter 5-2), SCOATES 317	5-3 – 5-4.1 5-4.2 – 5-4.3	Ch. 5: 26E, 32E, 37, 38 Ch. 5: 45, 46, 52E, 54, 64
7	25 27 March 1	Mixing chambers, heat exchangers, pipe flow Energy analysis of unsteady-flow systems Problems (Chapter 5)	5-4.4 – 5-4.5 5-5	Ch. 5: 71, 74, 77E, 73E Ch. 5: 95, 104, 114, 124E
8	4 6 8	Second law, heat engines, refrigerators, heat pumps Reversibility, Carnot cycle, Carnot principles Carnot heat engines, refrigerators, heat pumps	6-1 – 6-5 6-6 – 6-9 6-10 – 6-11	Ch. 6: 23, 25E, 26 Ch. 6: 42, 45, 55 Ch. 6: 78, 80E, 95, 102
9	11 15	SPRING BREAK		
10	18 20 22	Entropy: changes, processes, property diagrams TdS relations, entropy change liquids & solids Entropy change ideal gases, relative P and V; Problems: Chapter 7	7-1 – 7-6 7-7 – 7-8 7-9	Ch. 7: 27, 32, 36, 49 Ch. 7: 60, 63 Ch. 7: 73, 87E, 92, 93
11	25 27 29	Rev. steady-flow work Isentropic efficiencies Exam review (Chapters 5 through 7)	7-10 7-13	Ch. 7: 109E, 117 Ch. 7: 126, 143
12	April 1 3 5	Air cycles: Carnot, Otto, Otto cycle, Diesel cycle **EXAM 2** (Chapters 5 through 7) SCOATES 317	9-1 – 9-6	Ch. 9: 13, 16E, 33, 57
13	8 10 12	Brayton cycle, regeneration Rankine cycle Rankine cycle with reheat, Problems (Chapter 10)	9-8 – 9-9 10-1 – 10-2 10-3 – 10-5	Ch. 9: 83, 90, 109 Ch. 10: 15E, 18E, 25 Ch. 10: 31, 32
14	15 17 19	Refrigeration, heat pumps Gas mixtures, atmospheric air Problems (Chapter 11 and 13)	11-1 – 11-4, 11-7 13-1 – 13-3	Ch. 11: 4E, 17, 44 Ch. 13: 11, 33, 37
15	22 24 26	Atmospheric air, psychrometric chart Psychrometrics, air conditioning processes Psychrometrics Problems	14-1 – 14-5 14-6 – 14-7 14-6 – 14-7	Ch. 14: 11, 27E, 41, 43E, 44E Ch. 14: 57E, 67, 73 Ch. 14: 78, 93, 102
	April 29	Review (Friday schedule)		
	May 6	**FINAL EXAM, SCOATES 317, 10.30AM**		

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A. Professional Preparation

Degrees held

Budapest University of Technology and Economics, Hungary Biological and Chemical Engineering B.Sc., 1979
Budapest University of Technology and Economics, Hungary Biochemistry and Food Technology M.S., 1985
Academy of Sciences, Berlin, Germany Biotechnology / Chemistry Ph.D., 1986

Postdoctoral research

Rutgers University (New Brunswick, NJ), Recombinant fungal systems, 1989-1990
Int. Centre for Genetic Engineering and Biotechnology (Trieste, Italy), 1990-1991
Cornell University (Ithaca, NY), Regulation of ACC synthase gene, 1992-1993

B. Appointments

Assistant Professor, Dept. Biological and Agricultural Eng, TAMU, September 2017-present.
Research Associate Professor, Aerosol Technology Laboratory, Dept. Mech. Eng, TAMU, 2014 – 2017.
Research Associate Engineer, Aerosol Technology Laboratory, Dept. Mech. Eng, TAMU, 2005 – 2014.
Senior Research Scientist, Dept. Biochemistry and Biophysics, TAMU, TX, 2002 – 2005.
Senior Research Associate, Dept. Agronomy and Range Science, UC Davis, CA, 2000 – 2002.
Research Associate, Biotechnology, Seminis Vegetable Seed Research Center, CA, 1996 – 2000.
Head of Dept. Biochemistry, Central Food Research Institute (CFRI), Budapest, 1993 – 1996.
Senior Scientist, Head of Immunology Laboratory, Dept. Biochemistry, CFRI, 1986 – 1993.
Research Scientist, Dept. Enzymology, Central Food Research Institute, Budapest, 1979 – 1986.

C. Products (61 peer reviewed journal papers, 3 book chapters, 2 patents)

1. Environmental bioaerosol – nanoaerosol collection, tracking and analysis

a. Stowers, C., King, M., Rossi, L., Zhang, W., Arya, A. and Ma, X. (2018). Initial Sterilization of Soil Affected the Interactions of Cerium Oxide Nanoparticles and Soybean Seedlings (Glycine max (L.) Merr.) in a Greenhouse Study. ACS Sustainable Chemistry & Engineering, 6 (8): 10307–10314.
b. Estrada-Perez, C.E., Kinney, K.A., Maestre, J.P., Hassan, Y.A. and King, M.D. (2018). Droplet Distribution and Airborne Bacteria in an Experimental Shower Unit. Water Research, 130: 47-57.
c. Meng, F., King, M.D, Hassan, Y.A., and Ugaz, V.M. (2014). Localized fluorescent complexation enables rapid monitoring of airborne nanoparticles. Environmental Science: Nano, 1: 358-366.
d. Hoisington, A., Maestre, J.P., King, M.D., Siegel, J.A. and Kinney, K.A. (2014). Characterizing the Indoor Microbiome with Pyrosequencing: Impact of Sampler Selection. Building & Environment, 80: 1-9.
e. Kesavan, J., Schepers, D.R., Bottiger, J.R. King, M.D. and McFarland, A.R. (2013). Aerosolization of Bacterial Spores with Pressurized Medical Dose Inhalers. Aerosol Science and Technol., 47(10): 1108-17.

2. Development of the wetted wall cyclone collection technology

a. Lauterbach, S., Wright, C., Zentkovich, M., Nelson, S., Lorbach, J., Bliss, N., Nolting, J., Pierson, R., King, M. and Bowman, A. (2018). Detection of influenza A virus from agricultural fair environment: air and surfaces. Preventive Veterinary Medicine, 153: 24-29.
b. King, M.D. and A.R. McFarland. (2012). Bioaerosol Sampling with a Wetted Wall Cyclone: Cell Culturability and DNA Integrity of *Escherichia coli* Bacteria. Aerosol Science and Technology, 46: 82–93.
c. King, M.D. and A.R. McFarland. (2012). Use of an Andersen Bioaerosol Sampler to Simultaneously Determine Culturable Particle and Culturable Organism Size Distributions. Aerosol Science and Technology, 46: 852–861.

d. McFarland, A.R., Haglund, J.S., King, M.D., Hu, S., Phull, M.S., Moncla, B.W. and Seo, Y. (2010). Wetted Wall Cyclones for Bioaerosol Sampling. Aerosol Science and Technology, 44(4): 241-252.
e. King, M.D., Thien, B.F., Tiirikainen, J.S. and McFarland, A.R. (2009). Collection characteristics of a batch-type wetted wall bioaerosol sampling cyclone. Aerobiologia, 25(4): 239-247.

3. Development of novel biosensing and bacterial diagnostic technologies
a. Li, R., Goswami, U., King, M.D. and Rentzepis, P.M. (2018). In-situ detection of live/dead bacteria: A synchronous fluorescence, PCA study. PNAS, 115 (4): 668-673.
b. Kish, L.B., Chang, H-C., King, M.D., Kwan, Ch. et al. (2011). Fluctuation-Enhanced Sensing for Biological Agent Detection and Identification. IEEE Transactions on Nanotechnology, 10(6): 1238-1242.
c. Chang, H-C., Kish, L.B., King, M.D. and Kwan, Ch. (2009). Fluctuation-enhanced sensing of bacterium odors. Sensors and Actuators B (Chemical), 142: 429–434.
d. Kish, L.B., Schmera, G., King, M.D., Cheng, M., Young, R. and Granqvist, C.G. (2008). Fluctuation-Enhanced Chemical/Biological Sensing and Prompt Identification of Bacteria by Sensing of Phage Triggered Ion Cascade (SEPTIC), Internat. J. High Speed Electronics and Systems. 18: 11-18.
e. Dobozi-King, M., Seo, S., Kim, J.U., Young, R., Cheng, M. and Kish, L.B. (2005). Rapid nanoscale detection of bacteria: SEnsing of Phage-Triggered Ion Cascade (SEPTIC). J. Biol. Chem. Phys. 5: 3-7.

D. Synergistic Activities
Education:
Teaching: One undergraduate and three graduate courses in Molecular Biotechnology at Texas A & M.
Committee membership: Co-chair or member on 85 graduate committees, including 6 Ph.D. students. Graduate student internships (2) and directed studies (16).
Major Professor for 1 PhD and 3 MS students (one graduated in 2017).

Review activities:
Reviewer for 5 journals including *Aerosol Science and Technology (*AS&T*), Journal of Applied Microbiology* and *Journal of Aerosol Science*.
Reviewer for funding agencies including the National Science Foundation, USDA and DTRA.

Services:
Serving on several professional committees at different levels and organizations such as the AAAR conference committee and the European Biochemists' Society. Chaired/co-chaired several sessions in national and international conferences. Director of the Aerosol Technology Laboratory and the Bio-Chem Air Quality & Mold Analysis Laboratory, helping the community with air quality testing.

Selected Other Experience and Professional Memberships:
2006 Member, American Association of Aerosol Research (AAAR)
2017 Member, American Association for the Advancement of Science (AAAS)

Honors:
2005 Michele Costato Award, Best Conference Presentation, UpON Conference, Italy
2005 Science and Technology: Screening for screams; Bacteriology. The Economist. London, 2005. 375(8422):81.
2012 Guest Editor, "Biosensors"
2014 "Professor of the Year 2013-2014" Texas A&M University Award
2015 Appreciation of Dedicated Service to the Professional Program in Biotechnology, Texas A&M
2016 Guest Editor, Special Issue "Environmental Nanotechnology" in Journal of Nanomaterials
2017 Outstanding Reviewer Award, Aerosol Science and Technology