

## ME 405: Thermal Systems Design

<i>Course description:</i>	Design and analysis of thermofluid systems using principles of thermodynamics, fluid mechanics and heat transfer.
<i>Number of credits:</i>	3
<i>Course Coordinator:</i>	P. Dutta
<i>Prerequisites by course:</i>	ME 304; admitted to major in Mechanical Engineering
<i>Prerequisites by topic:</i>	<ol style="list-style-type: none"><li>1. Thermodynamic properties of matter.</li><li>2. Work and heat.</li><li>3. The first and second laws of thermodynamics.</li><li>4. Laminar and turbulent flow of ideal and viscous fluids.</li><li>5. Boundary layer flow and pipe flow.</li><li>6. Conductive, convective, and radiative heat transfer.</li></ol>
<i>Postrequisites:</i>	None
<i>Textbooks/other required materials:</i>	S.G. Penoncello, <i>Thermal Energy Systems: Design and Analysis</i> , CRC Press, Taylor Francis Group, 1/e, 2015.
<i>Course objectives:</i>	<ol style="list-style-type: none"><li>1. The first law of thermodynamics.</li><li>2. Calculation of heat loss.</li><li>3. Design of piping systems.</li><li>4. Pump selection.</li><li>5. Calculating conductive, convective, and radiative heat transfer in engineering systems.</li><li>6. Analysis of heat exchangers.</li><li>7. Second law of thermodynamics.</li><li>8. Gas and vapor power cycles.</li><li>9. Optimization of multicomponent thermofluid systems.</li></ol>
<i>Topics covered:</i>	<ol style="list-style-type: none"><li>1. The first and second laws of thermodynamics.</li><li>2. Availability and work potential.</li><li>3. Heat loss and heat load calculation.</li><li>4. Piping systems and pump selection.</li><li>5. Conductive, convective, and radiative heat transfer in engineering systems.</li><li>6. Heat exchangers.</li><li>7. Gas power, vapor power and refrigeration cycles.</li><li>8. Cogeneration and waste heat recovery.</li><li>9. Heating, ventilation and air conditioning system.</li></ol>

*Expected learning outcomes:*

1. Apply the first law of thermodynamics to open and closed systems.
2. Predict the head loss of a pipe or duct system and select an appropriate pump.
3. Determine the heat load of an engineering system.
4. Design a heat exchanger.
5. Apply the second law of thermodynamics to open and closed systems.
6. Optimize the conceptual design of a heat engine and refrigeration system.
7. Design a thermofluid system involving moving fluids, heat transfer, and conversion of energy between heat and work.

*Class schedule:*

Three 50-minute lecture sessions per week, for one semester.

*Laboratory schedule:*

None.

*Contribution to meeting the professional component:*

Engineering Topics

*Relationship of course to student outcomes:*

Meets:

1. School of MME educational objectives: 1, 2, 3
2. School of MME program outcomes: 1, 2, 3, 4, 5, 6, 7
3. ABET EC2019, Criterion 3 program outcomes: 1, 2, 3, 4, 5, 7

*Prepared by:* Andrea Butcherite and P. Dutta

*Date:* May 30, 2018

#### **POLICIES**

A. **Reasonable Accommodation** (the nature of the particular course determines which one applies):

- **Pullman Campus.** Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- **WSU Online Course.** Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri-Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).

#### **B. Academic Integrity**

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.

#### **C. WSU Safety**

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu> to become familiar with the information provided.