

ME 304: Heat Transfer

This is a cooperative course taught jointly by WSU and the University of Idaho

<i>Course description:</i>	Conduction, radiation, and convection heat transfer; analytical, numerical, experimental results for solids, liquids, and gases; heat exchanger design.
<i>Number of credits:</i>	3. This course is required.
<i>Course Coordinator:</i>	S. Banerjee
<i>Prerequisites by course:</i>	ME 301; ME 303; admitted to major in Mechanical Engineering
<i>Prerequisites by topic:</i>	<ol style="list-style-type: none">1. Differentiation2. Integration3. Conservation of mass4. Conservation of momentum5. Conservation of energy
<i>Postrequisites:</i>	ME 405, ME 406, ME 416, ME 419
<i>Textbooks/other required materials:</i>	Y.A. Cengel and A.J. Ghajar. <i>Heat and Mass Transfer: Fundamentals and Applications</i> . McGraw-Hill, 6/e, 2020.
<i>Course objectives:</i>	<ol style="list-style-type: none">1. Understand the modes of heat transfer and thermo-physical properties2. Application of energy conservation equation for thermal problems3. Calculate temperature and heat flux in one and two-dimensional conduction4. Calculate temperature and heat flux in unsteady conduction5. Understand velocity and thermal boundary layers6. Use boundary layer theory to determine velocity and temperature profile in external flows7. Evaluate heat transfer in internal flows for both developing and fully developed regions8. Calculate heat transfer rate and effectiveness of different heat exchangers9. Understand radiation properties and surfaces for heat transfer10. Calculate radiative heat transfer rate among surfaces
<i>Topics covered:</i>	<ol style="list-style-type: none">1. Introduction and basic concepts2. Introduction to conduction3. One-dimensional, steady-state conduction4. Two-dimensional, steady-state conduction5. Transient conduction

6. Introduction to convection
7. External flow heat transfer
8. Internal flow heat transfer
9. Natural convection heat transfer
10. Heat exchangers
11. Radiation heat transfer

Expected learning outcomes:

1. Ability to formulate governing partial differential equation(s) and necessary boundary (and initial) conditions for any thermal problem
2. Ability to determine the temperature and heat flux distribution using energy conservation and/or Fourier heat law
3. Ability to determine the heat flux and temperature distribution in steady state one-dimensional problems using thermal resistance concept
4. Ability to use numerical and/or graphical techniques to find the temperature distribution in two- and three-dimensional problems
5. Ability to apply analytical techniques to find the temperature distribution in transient conduction problems
6. Ability to use the energy transport equation to determine the temperature and heat flux distribution in laminar flow
7. Ability to determine the heat flux in turbulent flows using empirical equations
8. Ability to estimate the heat transfer rate for different heat exchangers
9. Ability to calculate different radiative properties associated with heat transfer

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
2. School of MME Program Outcomes: 1
3. ABET EC2019, Criterion 3: 1

Prepared by: Amy Johnson and S. Banerjee

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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.