



# MECH xxx

## Thermal Radiation (3 Credits)

### Course Syllabus

#### Instructor

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#### Course Outline

1. Introduction
  - 1.1. Definitions
  - 1.2. Electromagnetic spectrum, Planck's Law, Wien's Displacement Law, blackbody surfaces
  - 1.3. Absorptivity, Emissivity, Reflectivity, Kirchoff's Law
  - 1.4. Spectral/total, directional/hemispherical properties
2. Surface Radiation
  - 2.1. Diffuse/specular surfaces, gray/non-gray surfaces
  - 2.2. Radiation exchange, configuration factors
  - 2.3. Radiation shields, cavities
  - 2.4. Radiosity Method
  - 2.5. Monte Carlo Method
3. Participating Media
  - 3.1. Extinction, absorption, and scattering coefficients; optical thickness; albedo
  - 3.2. Bouguer's Law, emission within a medium
  - 3.3. Spectral/total absorptance, emittance, and transmittance
  - 3.4. Scattering, phase function
  - 3.5. Equation of radiative transfer, source function
4. Solution Methods
  - 4.1. Approximations: near transparent, emission, diffusion, two flux model.
  - 4.2. Monte-Carlo for participating media

#### Course Objectives

This course will provide students with a fundamental basis of thermal radiation heat transfer, as well as an introduction to analytical and numerical methods suitable for analyzing idealized and practical engineering systems involving thermal radiation. Students will apply their understanding of thermal radiation to consider applications related to heat transfer, as well as light-matter interactions for instrumentation applications.



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## Evaluation Criteria

Students will be evaluated based on assignments (~4), a midterm examination and a final examination. Assignments will include analytical exercises, as well as those requiring numerical solutions (e.g., Matlab, Python). Where appropriate experimental data will be provided for analysis.

Students enrolled in MECH 5xx will complete a term project including a report and presentation focussing on a topic related to radiative energy transfer and its applications. This topic can be assigned by the instructor or proposed by the student (pending instructor approval). Exams and assignments for MECH 5xx will include additional and/or more advanced questions.

## Grade Weighting

MECH 4xx		MECH 5xx	
Assignments	30%	Assignments	15%
Midterm	30%	Project and presentation	15%
Final	40%	Midterm	30%
		Final	40%

**NOTE:** In undergraduate MECH courses where at least 50% of the final grade is assigned to examinations, students may only **pass the course if they achieve a weighted average examination grade of at least 50%**. The "examination grade" includes scores from the final examination, midterms, and other tests done individually in a classroom setting. This policy applies unless it is explicitly waived by the instructor in the course syllabus. This policy is also available in the *Vancouver Academic Calendar* at <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,195,272,43>.

## References

The required readings will be assigned from:

Thermal Radiation Heat Transfer. John Howell, Robert Siegel, M. Pinar Menguc. CRC Press, 2010.

*Other editions may be substituted.*

Students are also encouraged to use the following references to increase their understanding of the material:

Radiative Heat Transfer. M.F. Modest. Academic Press, 2003.

Radiative Transfer. H. C. Hottel and A. F. Sarofin. McGraw Hill, 1967.

Radiative Heat Transfer by the Monte Carlo Method, in *Advances in Heat Transfer*. W. J. Yang, H. Taniguchi, and K. Kudo. Academic Press, 1995



## Plagiarism and Misconduct

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. Further information can be found in the UBC Calendar at:

<http://www.calendar.ubc.ca/Vancouver/index.cfm?tree=3,54,111,959>

The consequences of academic misconduct can range from a grade of zero on the work in question, to expulsion from your program. It is your responsibility to read, understand and abide by these regulations. Note that plagiarism detection tools are used on submitted projects and reports (UBC uses turnitin.com). If it is not clear to you what constitutes plagiarism, it is your responsibility to review the above calendar section and/or consult the course instructor – *prior to submitting work*.

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