Office: EG4231 email: yunw@uci.edu

# CONDUCTION HEAT TRANSFER SYLLABUS

**Catalog Data:** **MAE220: Conduction Heat Transfer** (Credit Units: 3). Steady state and transient conduction heat transfer in one- and multi-dimensional geometries. It emphasizes analytical methods, exact and approximate. Numerical techniques are also included. Prerequisite: MAE120.

**Textbooks:**

- *Heat Conduction, 2nd Edition,* M. Necati Özisik, John Wiley & Sons Inc. 1993.

**References:**

- *Conduction Heat Transfer,* Vedat S. Arpaci, Prentice Hall, 1984.
- *Conduction of Heat in Solids, 2nd Edition,* Carslaw, H.S. and J.C. Jaeger, Oxford University Press, 1986.
- *Conduction Heat Transfer,* Poulikakos, D., Prentice-Hall, 1994.
- *Heat Conduction, 3rd Edition,* Kakac, S. and Y. Yener, Taylor & Francis, 1993.
- *Analytical Methods in Conduction Heat Transfer*, Myers G.E., AMCHT Publications, 2nd edition, 1998.
- *Nanoscale Energy Transport and Conversion, G. Chen, Oxford, 2005.*
- *Nano/Microscale Heat Transfer, Z.M. Zhang, McGraw-Hill, 2007.*

**Instructor:** Prof. Wang (4231EG) email: yunw@uci.edu

**Class info:** Room: DBH 1431
Day & time: T T 12:30 pm to 1:50 pm
Office hours: T T 11:10 am to 12: 00 pm

**Course Outcomes:** Students will be able to:

- Understand heat conduction phenomena in solid.
- Derive the heat conduction equation from basic principles and simplify it for a given application.
- Identify and apply proper boundary conditions.
- Apply the principle of superposition to problems.
- Use the separation of variables method to solve 2-D steady state problems and 1-D unsteady state problems.
- Use the Green's function and LaPlace transform methods to solve heat conduction problems.
- Develop finite difference formulations for steady/unsteady state problems.

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| **Prerequisites By Topic:** | Heat Transfer MAE 120 |
| **Lecture Topics:** | 1. Introduction to heat transfer<br>2. Heat conduction equation, boundary/initial conditions, lumped system formulation, and normalization.<br>3. Solution to ODEs and Bessel functions<br>4. SOV (Separation of variables).<br>5. Superposition and applications of Duhamel's theorem.<br>6. Green's function approach and Laplace transforms.<br>7. Fourier transform and similarity<br>8. Finite difference methods.<br>9. Phase-change problems.<br>10. Moving heat source problems.<br>11. Others.<br>* *some topics may not be covered in class.* |
| **Class Schedule:** | Each class meets 3 hours per week for 10 weeks. |
| **Computer Usage:** | Used for homework problems (Fortran/C, Matlab and Mathcad) and homework writing (Word, Excel). |
| **Class Projects:** | A project will be given around 7th week. Each student must individually complete a project related to heat conduction and submit his/her project report. |
| **Professional Component:** | Contributes toward the Mechanical Engineering Topics courses. |
| **Relationship to Program Outcomes:** | This course relates to the MAE Graduate Program as stated at:<br>http://mae.eng.uci.edu/grad/graduate_program.html |
| **Design Content Description** | |
| **Grading Criteria:** | Homework: 20%<br>Midterm: 20%<br>Final: 40%<br>Project: <u>20%</u><br>100% |

Prepared by Prof. Y. Wang
Jan. 2013