

Thermal Conduction

M.E. 5316

Fall 2009

This course introduces students to the fundamentals of heat conduction in solids. Exact and approximate methods are discussed. The approximate methods include finite difference, finite element, and weighted residual type analyses using variational calculus.

List of Topics

1. Introduction to Laplace Transform (Class Notes).
2. Derivation of the diffusion equation.
3. Heat conduction in infinite bodies; using the Green's function in an infinite body.
4. Heat conduction and Green's function in semi-infinite bodies.
5. Generalized Green's function solution method.
6. The alternative Green's function solution method.
7. Transient and steady state heat conduction in finite bodies:
 - a. Cartesian coordinates.
 - b. cylindrical coordinates.
 - c. spherical coordinates.
8. Approximate methods:
 - a. variational calculus and Galerkin method.
 - b. finite difference.
 - c. finite element method.

Exams: Open Book and Open Notes

1 Midsemester (50%)

1 Final (50%)

Text: Selected course materials will be on the website; see the ME5316 website for class notes.

References:

1. Heat Conduction Using Green's Functions by Beck et al.
2. Heat Conduction by N. Ozisik, Wiley.
3. Analytical Methods in Conduction Heat Transfer G. E. Myers, McGraw-Hill.

Objective: The course objective is to discuss the fundamentals of thermal conduction, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems, and unsteady and transient temperature distribution in solid structures. Additionally, the goal is to familiarize students with fundamentals of engineering/physics and mathematical/numerical techniques needed to handle advanced thermal conduction problems in engineering.

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