

ADDIS ABABA UNIVERSITY
AAiT
School of Mechanical and Industrial Engineering
MSc Thermal Engineering

Computational Heat Transfer (MEng 6302)

Semester II 2020 G.C, 2012 E.C.

Instructor Dr. Yilma T.

Course Outline

- 1. Introduction**
Formulation of Conduction Heat Transfer and introducing Computational tools
- 2. Application of FDM for Heat Conduction**
 - 2.1 Review of FDM Discretization for 2D problems
 - 2.2 Variable mesh size composite walls
 - 2.3 Radial systems
 - 2.4 Time stepping techniques for transient problems
 - 2.5 Time dependent boundary conditions
- 3. Application of FEM for Heat conduction**
 - 3.1 Review of FEM discretization
 - 3.2 Steady state problems in plane for radial domains
 - 3.3 FE programming structure for steady state problems
 - 3.4 Transient problems
 - 3.5 FE programming structure for transient problems
 - 3.6 Time dependent boundary conditions
- 4. Non linear heat conduction and phase change analysis for FEM**
 - 4.1 steady state nonlinear heat conduction
 - 4.2 Transient non linear heat conduction
 - 4.3 Solidification and Melting
- 5. Analysis of Laminar Convection heat transfer by FDM**
 - 5.1 Boundary layer equation
 - 5.2 Discretization of continuity and momentum equation
 - 5.3 Discretization of energy equation
 - 5.4 Solution techniques
- 6. Film Condensation analysis by FDM**
- 7. Numerical Analysis of Radiation Heat Transfer**
 - 7.1 Numerical approximation of Shape factors
 - 7.2 Radiative exchange using finite elements
 - 7.3 Coupled conduction radiation problems

Mini project

1. 2D FDM analysis of a chimney X-section with composite walls
2. Transient analysis heating for a plane in a furnace of FDM using implicit and explicit techniques
3. 2D FEM analysis of a chimney with composite wall using isoparametric elements and numerical integration
4. Transient analysis of a Chimney with composite wall during warming up by FEM
5. Building heat transfer analysis
6. One dimensional solidification model
7. Laminar boundary analysis by FDM
8. Film condensation by FDM
9. Radiative heat exchange between two shells by FEM
10. Convective heat transfer analysis with fluent

Text Book

1. Lewis and Morgan : Finite Element Techniques in Heat Transfer analysis
2. Numerical heat Transfer
3. Computational Fluid Mechanics

Assessment Criteria

- Selected mini projects and assignments (3) 50%
Final exam 50 %