



**THE OHIO STATE UNIVERSITY**  
COLLEGE OF ENGINEERING

# Engineering Analysis for Design and Simulation

## WELDENG 4201

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**Credit Hours:**

4.00

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**Course Levels:**

Undergraduate (1000-5000 level)

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**Course Components:**

Lecture

Lab

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**Course Description:**

Fundamentals of engineering analysis of heat flow, thermal and residual stresses, and fracture and fatigue with applications to design and simulation in welding and manufacturing.

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**Prerequisites and Co-requisites:**

Prereq: 2001 or 3001; and Math 2177, or 2255, or 2415, or 2174; and MechEng 2040 or 2020; and Engr 1221 or 1281H; and enrollment in WeldEng major; or permission of instructor.

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**Course Goals / Objectives:**

- Obtain fundamental understanding of heat flow including heat conduction with moving heat sources
  - Obtain basic understanding of causes for and development of thermal stresses, residual stresses and distortion
  - Obtain basic understanding of linear elastic fracture mechanics including ability to apply fracture criteria
  - Obtain basic understanding of high cycle fatigue, effect of mean stress using Goodman diagram, and life prediction for a variety of structures including welded structures
  - Ability to analyze and design simple welded joints
  - Obtain basic understanding of and ability to apply finite difference and finite element modeling to simple heat flow, stress analysis and fracture mechanics problems
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**Course Topics:**

- Introduction to heat flow including steady state conduction.
  - Finite difference and finite element modeling of heat flow.
  - Heat flow with moving heat sources including Cooling rates and peak temperature equations.
  - Introduction to thermal stresses, residual stresses and distortion.
  - Three-bar analogy analysis for residual stresses and distortion.
  - Residual stress measurement, stress relieving, and distortion analysis.
  - Introduction to fracture mechanics, stress intensity factors and fracture toughness.
  - Introduction to high cycle fatigue, Goodman diagram, and fatigue of welded structures.
  - Welded joint analysis and design.
  - Matlab programming and application to heat flow and finite difference modeling.
  - Abaqus modeling of steady state and transient heat flow.
  - Abaqus analysis of elastic, thermo-elastic and thermo-elastic-plastic problems.
  - Abaqus analysis of fracture.
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**Designation:**

Required