THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Computational Modeling of Additive Manufacturing and Welding (Grad)

WELDENG 7115

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture
Lab

Course Description:
Graduate-level instruction on the theory of temperature, stress, deformation and phase transformation for additive manufacturing and welding, as well as application of industry-standard simulation codes.

Prerequisites and Co-requisites:
Prereq: Grad standing in Engineering, Mathematics, Physics, or Chemistry; or permission of instructor.

Course Goals / Objectives:
- Develop a basic understanding of the theory of heat transfer, stress and deformation, and phase transformation including the governing partial differential equations.
- Understand the basics of commonly-used numerical methods including finite difference and finite element methods.
- Pose practical problems in terms of physical phenomena, formulate solutions using computational models, and understand the assumptions made as well as limitations of these models.
- Apply industry-standard finite element codes and material modeling software to solve practical additive manufacturing and welding problems.

Course Topics:

- Introduction
- Python programming lab – Part I
- Theory of heat conduction
- Python programming lab – Part II
- Finite difference solution to heat conduction
- Thermal modeling lab in Abaqus – Part I (geometry)
- Finite element solution to heat conduction
- Thermal modeling lab in Abaqus – Part II (Meshing)
- Theory of residual stresses in welding
- Thermal modeling lab in Abaqus – Part III (Visualization of Results)
- Finite element formulation for 2-D elastic elements
- Matlab programming lab of elastic elements
- Origin of residual stresses and deformation
- Stress modeling lab in Abaqus
- Advanced topics on metal plasticity
- Guest lecture #1
- Computational materials modeling
- Thermodynamics simulation lab in Thermo-Calc
- Thermodynamics and CALPHAD
- Scheil simulation lab for non-equilibrium solidification
- Kinetics of phase transformation
- Diffusion simulation lab in Dictra
- Mathematics of diffusion
- Diffusion and precipitate simulation lab in TC-Prisma
- Other topics, e.g., experimental validation
- Guest lecture #2

Designation:
Elective