Instructor: Dr. Stephen Liu
HH 254
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Time: M & W 4:00 - 5:15 PM

Room: HH 211

Textbook: No Textbook required.
Recent publications or classical papers in the welding literature will be used.

Course Topics:
1. Weld Thermal Experience & Weld Pool Mechanics - Temperature Field Modeling, Weld Morphology Modeling, Different Driving Forces and Contributions
2. **Residual Stress Management – Modeling of Residual Stress Development, Methods to Counteract Residual Stress, Coefficient of Thermal Expansion, Phase Transformation Induced Stress, \( M_t \) and \( M_d \)
3. Weld Metal Solidification - Solidification Modeling, Microsegregation Effects, Back Diffusion, Grain Refinement - Second Phase Particles Effects, Fluid Flow Effects
5. **High Strength Steel Pipeline Welding & Heat Affected Zone - Strength/Toughness Matching, Large Scale Testing Fracture Mechanics, Adequacy of Carbon Equivalent Concepts, Reheated Zone Formation, Microstructural Stability, HAZ-less Steels
6. **Nickel Alloy Welding – Alloys for Power Generation, Nil Ductility Dip Phenomenon, Liquation Cracking
7. Hydrogen in Weldments - Martensite Start Temperature as Weldability Index, Porosity Formation, Hydrogen Embrittlement, Microfissuring, Hydrogen Flux between Weld Metal and HAZ
8. Stainless Steel Welding - Duplex and Super Duplex Stainless Steel Welding, Supermartensitic Stainless Steel Welding
9. **Welding of Aerospace Materials - Structural Aluminum Alloys (e.g., 2XXX, 6XXX, 7XXX, etc.) Welding - Property Fluctuations, Liquation Cracking
**Structural Titanium Alloys (α Alloys, β Alloys, α/β Alloys) Welding - Property Fluctuations, Base Metal Interstitial Contamination**

10. **Metallurgy of Friction Stir Welds – Different Weld Zones, Effects of Thermal and Mechanical Cycles, Weld Metal Homogeneity**


**Topics for student development**

**Course Format**
- Seminar Format
- Student Presentation - Based on a minimum of 15 or more recent (since 1998), relevant publications and standard/classical texts; Quality Handouts
- Q&A
- Discussion
- Group Participation

**Grading System:**
- 8 to 10 Quizzes (one on each topic discussed)
- 2 Lecture Presentations ( QCGM - Quality Content, Graphics, and Micrographs)
- 1 Presentation Quality Poster
- 1 Final Report (3500 Words plus Graphics) on selected topics on Welding and Joining
- Submit Bibliography (at least 15 complete references with quality pdf files ) - 3rd Week of Class
- Submit Outline - 5th Week of Class
- Submit Final Report - Monday Dead Week
References: