MSE 415 – Transport/Kinetics

Credits and contact hours:	4 credits and 60 contact hours
Indicate: math, basic science, engineering topic or other	Engineering topic
Instructor's or course coordinator's name:	Dr. Howard Poisl
Textbook, title, author and year:	A textbook is a useful reference to study, get more information, solve problems, etc., but is only a tool. Lectures will generally follow "Transport Phenomena Fundamentals" 3rd or 4th Edition by Joel L. Plawsky, but will not be strictly based on any one textbook. Another relevant textbook is "Transport Phenomena in Materials Processing" by Poirier and Geiger. Quizzes and practice problem sets will contain material from power points, in class lectures, and multiple written resources. You may also want to acquire a university level ordinary differential equations textbook.
Other Supplemental materials:	None
2021-2022 catalog description:	Principles of heat transfer, diffusion, mass transfer and kinetics, as applied to materials processing.
Prerequisites:	Advanced Standing
Co-requisites:	None
Required, Elective, or Selected Elective:	Required
Instruction Outcomes:	1.) Develop an understanding of the balance equation in diffusive transport. 2.) Demonstrate and streamline transport phenomena through a unified treatment. 3.) Develop an understanding of the interconnectedness between materials properties and the effects on the physical behavior of the system and underlying mathematical description. 4.) Develop mathematical models and solutions through pattern matching and comparative analogies. 5.) Develop the ability to validate basic numerical solutions

and understand when numerical solutions provide physical and reasonable solutions

Student Outcomes –

Listed in Criterion 3 or any other outcomes are addressed by the course:

To produce graduates who can:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topics covered:

- UNIT 1 Introductory Concepts and Flows, Gradients, and Transport Properties
  Momentum, Energy, Mass, and Charge Transport; Driving Force/Resistive, Concepts, Fluxes in 2D and 3D, Mechanistic differences between transport phenomena, Primary and secondary fluxes, Failure of the Linear Flux (Gradient Laws)
- UNIT 2 Transport Properties of Materials
  Kinetic Theory of Gases, Viscosity of Gases & Liquids, Thermal conductivity of gases, liquids, and solids, Diffusivity of gases, liquids, and solids, Conductivity, mobility, and resistivity, Generation and Accumulation introduction
- UNIT 3 Heat Transfer Detailed Concepts
  Boundary conditions – convection, equilibrium, radiation – and boundary condition catalog, 1D, Lumped Capacitance, Steady-state transport, Composite Media, Variable Transport, Coupled Transport and Multiple Fluxes
- UNIT 4 Mass Transfer Detailed Concepts
  Boundary conditions and 1D Transport, Constant Generation, Variable Generation and Coupled Transport, Lumped Capacitance, Internal Gradients and Generalized Solutions, Semi-Infinite Systems, Moving Boundary Problems
- UNIT 5 Kinetics
  Nucleation in condensed phases, Nucleation and growth in solids, Grain Growth, Mixed Kinetics of gas-solid reactions