**Course number and name: MTSE 3040: Transport Phenomena in Materials**

**Credits and contact hours:** 3 Credits. Walk in or by appointment

**Instructor’s or course coordinator’s name**: Dr. Zhiqiang Wang

**Text book, title, author, and year**

Sindo Kou, “Transport Phenomena and Materials Processing”, Wiley-Interscience Publication, 1996.

1. *Other supplemental materials*

David R. Gaskell, "Introduction to Transport Phenomena in Materials Engineering" - Macmillan Publishing Company, 1992.

**Specific Course Information**

1. *Brief description of the content of the course (catalog description)*

Principles of transport phenomena in materials processes including momentum, heat and mass transport.

1. *Prerequisites or co-requisites*

Math 3310 and MTSE 3000, 3001

1. *Indicate whether a required, elective, or selected elective course in the program*

Required

**Specific goals for the course**

1. *Specific outcomes of instruction*

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| **Specific Course Learning Outcome** |
| 1. To solve heat transport problems with energy balance equations and Fourier’s law of conduction.
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| 1. To solve momentum transport problems with equations of continuity and law of viscosity.
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| 1. To solve mass transport problems in materials processing with Fick’s laws of diffusion and equations of mass balance.
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| 1. To learn materials processing technologies and the application of theory in these technologies.
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1. *Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.*

This course addresses ABET Student Outcome 7

**Brief list of topics to be covered**

I. Fluid Flow

Fluxes, Phenomenological laws, and Conservation laws

Momentum transfer and viscosity

 II. Heat Transfer

Modes of heat transfer (Conduction, Convection, and Radiation) Steady and unsteady state heat conduction

Heat transfer coefficients

III. Mass Transport

Fick's law and diffusivity of materials

Mass transfer in fluid systems, mass transfer coefficient

Diffusion as random thermal jumps of atoms (1 d random walk)

Self-diffusion coefficients

Vacancy and interstitial mechanisms of self-diffusion

Diffusion in ionic materials

Diffusion in presence of driving force and mobility

Interdiffusion and Darken’s equation Simple solution of diffusion equation

Grain boundary and surface diffusion

 IV. Similarities, Coupling and Boundary Conditions

 Coefficients of transfer

 Balance equations

 Coupling of different types of transport

 Solid/Liquid/Gas interfaces

V. Transport phenomena in Materials Processing

 Materials processing technologies

 Application of transport theory