MSE 414 – Solidification of Castings

Credits and contact hours:	3 credits and 45 contact hours
Indicate: math, basic science, engineering topic or other	
Instructor's or course coordinator's name:	Dr. David Poirier
Textbook, title, author and year:	None.
Other Supplemental materials:	**Selected readings from:** -D.R. Poirier and G.H. Geiger, *Transport Phenomena in Materials Processing,* TMS, Warrendale, PA 1994 (Chapter 10 - Solidification of Metals). -J. Campbell, *Castings,* Inst. British Foundrymen, Birmingham, U.K., 1993. -H.F. Taylor, M.C. Flemings, and J. Wulff, *Foundry Engineering,* John Wiley, New York, NY, 1959. -M.C. Flemings, *Solidification Processing,* McGraw-Hill, New York, NY, 1974
2020-2021 catalog description:	Principles of metal castings while applying fundamentals of transport and materials science and engineering. Students work in teams on projects that provide experience in engineering design and hands-on use of the Metal Casting Laboratory.
Prerequisites:	AME 432 or CHEE 305, MSE 415; MSE 331r or MSE 110.
Co-requisites:	None
Required, Elective, or Selected Elective:	Elective
Instruction Outcomes:	1. Develop a familiarity with metal casting technology. 2. Demonstrate an ability to apply principles of conduction heat transfer to estimating solidification times and to designing of

risers.
3. Understand the development of dendritic structures during solidification.
4. To be able to apply principles of proper gating and risering to a casting.
5. Become familiar with making sand-mold castings and the melting and handling of molten metal by doing the "hands-on" work. This includes the safety considerations when working in such an environment.
6. Provide opportunity to work in small teams.
7. Effect their knowledge of both casting technology and fundamentals of materials science and engineering by coming up with optimal mechanical properties of a cast alloy.

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
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Topics covered:

1. Overview of casting processes (2 lecture-hrs).
2. Familiarity with casting lab and making molds (1 lab session).
3. Heat conduction applied to sand mold castings (2 lecture-hrs).
4. Project 1: Design of risers. (Team work plus casting-lab; each team submits casting by end of 6^{th} week).
5. Principles of designing gating systems (2 lecture-hrs)
6. Project 2: Casting design (Team work plus casting-lab; each team submits casting by end of 10^{th} week; evaluation of casting based on casting yield, soundness, simplicity of production, gating system and overall appearance.
7. Dendritic solidification and heat treating of aluminum alloy castings (3 lecture-hrs.).
8. Project 3: Optimizing the tensile properties of a casting alloy. (Team work in casting-lab and mechanical testing-lab; each team

casts a plate that are sectioned for heat treating, hardness testing and a bend test for ductility