

School of Engineering and Computer Science
Mech 442/542: Advanced Thermal Systems

Catalog Data:	Mech 442/542 Advanced Thermal Systems; 3 credits Analysis and design of advanced thermal systems at macro, mini, and micro scales, use of design software packages, performance of design projects.
Class Schedule:	Two 75-minute lectures per week, for one semester.
Laboratory Schedule:	None
Prerequisites by Course:	Mech 404
Prerequisites by Topic:	Knowledge and understanding fundamentals of: <ul style="list-style-type: none"> - engineering thermodynamics; thermodynamic properties of matter, work and heat, 1st and 2nd laws of thermodynamics - engineering fluid mechanics; fluid properties, Newton's 2nd law, similitude, laminar and turbulent flow, pipe flow, boundary layer flow - engineering heat transfer; conduction, convection, and radiation heat transfer
Recommended Texts:	None (some reference books plus class notes)
Course Coordinator:	Dr. Amir Jokar
Course Objectives:	<ol style="list-style-type: none"> 1. Combine the fundamentals of engineering thermodynamics, fluid mechanics, and heat transfer to analyze advanced thermal systems. 2. Apply the conservation laws, i.e., mass, momentum, and energy, on thermal systems under steady-state and transient conditions. 3. Explain and analyze the operation of vapor and gas power systems and predict their performance. 4. Explain and analyze the operation of refrigeration and air-conditioning systems and predict their performance. 5. Understand and explain advanced topics in thermal systems design, e.g., electronics cooling and thermal management, microchannel heat transfer and fluid flow, energy resources, renewable energy, thermal systems optimization, etc. 6. Learn, use, and implement appropriate software packages, such as Icepak and/or Fluent, in design projects. 7. Design, build, and test a thermal system, such as micro-scale heat sinks for electronics devices, and present the project in class.
Topics Covered:	<ol style="list-style-type: none"> 1. Vapor and gas power systems 2. Refrigeration and heat pump systems 3. Air conditioning and drying systems 4. Energy resources and renewable energy 5. Microchannel heat transfer and fluid flow 6. Heat conduction in extended surfaces 7. Natural convection in thermal systems 8. Thermal management in electronics devices 9. Two-phase flow, condensation and evaporation 10. Design-software packages

Lab Experiments and Activities:	This course does not intend to have any regular lab sessions; however, some of the equipment in the thermo/fluids lab will occasionally be used for the design projects to collect experimental data and compare them with the theory, such as using the electronics cooling wind tunnel to design and test micro-scale heat sinks for electronics devices.		
Course Outcomes:	Students will be able to:		
	Assessed for Program Outcomes	C-4. Build the thermal system based on the required specifications. H-3. Evaluate the environmental factor of engineering solutions in design projects or in some specific thermal/fluids problems. J-2. Evaluate the impact of engineering decisions on energy resources and savings, in some specific thermal/fluids problems.	
Other		C-2. Carry out design process, such as modeling, calculation, and iteration, to satisfy project requirements for a thermal system, such as heat sinks. C-3. Work within realistic constraints, such as economical, environmental, manufacturability, health and safety, ethical, and sustainability, in realizing the thermal system. E-3. Use analytical/computational/experimental analysis to obtain solutions for specific thermal/fluid problems. H-2. Examine economic tradeoffs in the design projects, or in some specific thermal/fluids problems. J-1. Evaluate the impact of contemporary issues, such as environmental, economic, emerging technologies, in their design projects, or in some specific thermal/fluids problems. K-1. Setup/operate data acquisition systems to collect experimental data in their design projects. K-4. Use appropriate software/numerical codes for analyzing specific thermal/fluid problems or for presenting their design projects.	
	Required or Elective Course:	Elective	
Contribution to Professional Component:	Engineering Topics		
Relationship of Course to Program:	Meets: Educational Objectives <u>1, 2, 3, 4</u> Program Outcomes <u>C, E, H, J, K</u>		
Prepared by:	Dr. Amir Jokar	Date:	October 10, 2008
Approved by CAC:			