WASHINGTON STATE UNIVERSITY
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School of Engineering and Computer Science

MECH 442/542: Advanced Thermal Systems

Catalog Data:	**442 Advanced Thermal Systems** 3 Course Prerequisite: MECH 404. Analysis and design of advanced thermal systems at macro, mini and micro scales; applied design software packages; design projects. Credit not granted for both MECH 442 and MECH 542. Offered at 400 and 500 level. Typically offered Spring.
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: - 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, convention, and radiation heat transfer
Textbook:	*Thermal Design & Optimization*, Adrian Bejan, George Tsatsaronis, Michael Moran, Wiley-Interscience.
Course Coordinator:	Dr. Sun Ung Kim
Course Objectives:	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:	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 Student Outcomes	2.d. Generate solutions that meet specified needs for engineering designs of advanced thermal systems. 4.a. Evaluate thermal engineering design solutions in consideration of the global, economic, environmental, and societal impacts.		
	Other	1.d. Apply mathematics, scientific and/or engineering principles toward solving thermal engineering problems. 2.b. Apply the engineering design process (such as concept generation, modeling, evaluation, and iteration) to satisfy project requirements for advanced thermal systems. 2.c. Analyze a thermal engineering system within realistic constraints, such as economic, environmental, social, cultural, global, public health, safety, welfare, and other factors appropriate to the discipline. 6.b. Use appropriate equipment and techniques for thermal system projects.		
Required or Elective Course:		Elective		
Contribution to Professional Component:		Engineering Topics		
Relationship of Course to Program:		Meets: Educational Objectives ?, ?, ? Student Outcomes 1, 2, 4, 6		
Prepared by:		Dr. Sun Ung Kim	Date:	7/14/2018
Approved by USC:				