Korea University International Summer Campus (KU ISC) 2024

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June 26, 2024 - August 1, 2024

ISC360 – Heat Transfer

Ⅰ. Instructor

Professor	:	Wonjoon Choi
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Home Institution	:	Korea University
Class Time	:	4 Week, Period 2 (13:10 - 15:40 KST)
Office	:	Innovation Hall – 316, [02841] Anam-dong, Seongbuk-gu, Seoul, 02841, Korea
Office Hours	:	By appointment

Ⅱ. Textbook

Required Textbook	:	Lecture notes will be distributed as core materials for each lecture.
Recommended Additional Readings	:	Introduction to Heat Transfer, F.P.Incropera & D.P.DeWitt ISBN-13: 978-0470501962 Heat Transfer, A.F. MILLS, Second Edition ISBN-13: 978-0139476242

Ⅲ. Course Description and Objectives

This subject is a core undergraduate course of mechanical engineering. Heat transfer is one of the most significant topics in terms of fundamentals and engineering applications. Topics to be covered include: steady state heat conduction, transient heat conduction, laminar and turbulent convection, natural convection, basic thermal radiation and their engineering applications. Final goal is understanding the fundamental theory, phenomena, and applications of heat and mass transfer in mechanical engineering.

This course has prerequisites of ‘Thermodynamics’, ‘Fluid Mechanics’, and ‘Engineering Mathematics’, but they are not mandatory.

A general overview of the topics to be covered is as follows.

FUNDAMENTALS OF HEAT TRANSFER
1. Introduction to conduction - governing equations, properties
2. One-dimensional steady-state conduction
3. 2-D steady heat conduction, Separation of variables
4. Transient conduction
5. Forced Convection-Internal flow

6. Forced Convection-External flow 7. Natural Convection 8. Two Phase Heat Transfer-Boling and condensation 9. Radiation - black body, gray body radiation and shape factor 10. Applications of heat transfer for engineering systems Problem sets (assignments) will be distributed. The homework assignments are essential for learning the course material, and a serious effort should be made to solve each problem. Students are encouraged to discuss with other class members in terms of the underlying concepts and approaches. However, such discussion must stop short of jointly prepared solutions. That is, the work turned in must reflect one's individual efforts.

Ⅳ. Grading

Midterm Exam		35%
Final Exam	:	45%
Assignments	:	10%
Participation	:	10%

Ⅴ. Class Outline

Date	Topic	Chapter	Remarks
June 26 (Wed)	*Orientation Day*		No class
June 27 (Thu)	Introduction to conduction – governing equations, thermophysical properties, overview of heat transfer modes, Fourier's law, boundary and initial conditions, thermal resistance and thermal circuits	Lecture note	Classes begin
June 28 (Fri)	One-dimensional steady-state conduction – methodology of a conduction analysis (plane wall, tube wall, spherical shell)	Lecture note	
July 1 (Mon)	One-dimensional steady-state conduction – heat conduction with internal energy generation, thermal insulation	Lecture note	
July 2 (Tue)	Heat transfer from extended surfaces – fin equations, boundary conditions of fins, fin effectiveness, efficiency, thermal resistance	Lecture note	
July 3 (Wed)	Two-dimensional steady-state conduction Transient heat conduction – dimensionless numbers, lumped thermal capacitance model, semi-infinite solid model	Lecture note	
July 4 (Thu)	Introduction to convection – basic principles, classification of convection, dimensionless numbers, governing equation, control volume analysis	Lecture note	
July 5 (Fri)	Forced convection (internal flow) – hydrodynamic and thermal consideration, analysis of developing regime and fully-developed flow, geometrical effects, heat transfer coefficient	Lecture note	

July 8 (Mon)	Midterm exam	Lecture note	
July 9 (Tue)	Forced convection (external flow) – laminar to turbulent transition, hydrodynamic and thermal boundary layer, similarity solution, heat transfer coefficient, geometrical effects	Lecture note	
July 10 (Wed)	Natural (Free) convection – driving force, dimensionless numbers, natural convection on a heated vertical plate, governing equation and assumption, estimation of Nusselt number, empirical heat transfer correlation for various geometries	Lecture note	
July 11 (Thu)	Condensation – working principles, dimensionless numbers, film and dropwise condensation, film condensation on a vertical plate,	Lecture note	
July 15 (Mon)	Boiling – working principles, dimensionless numbers, boiling curves and mode transition (nucleate boiling, film boiling, critical heat flux, Leidenfrost effect	Lecture note	
July 16 (Tue)	Radiation – general consideration (working mechanism, wavelength, electromagnetic spectrum, radiation intensity, directional characteristics), Stefan-Boltzmann law, blackbody radiation	Lecture note	
July 17 (Wed)	Radiation – surface radiative properties, gray-diffuse radiation, radiation exchange between surfaces (shape factor)	Lecture note	
July 18 (Thu)	Applications of heat transfer for engineering systems	Lecture note	
July 19 (Fri)	Final exam	Lecture note	
Aug 1 (Thu)	*Graduation Day*		