

MM 309E Heat Transfer				DEPARTMENT OF MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project / Field Study	Homework	Other	Total	Credit	ECTS Credit
5	42	14	-	30	-	39	125	4	5.0
Language	English								
Compulsory / Elective	Compulsory								
Prerequisites	MM 203E								
Course Contents	Heat transfer mechanisms, steady heat conduction, thermal resistances, fins. Transient conduction, lumped capacitance method, product solutions. Numerical methods in steady heat conduction and in transient heat conduction. Forced convection; boundary layers, laminar and turbulent flow, convective transfer boundary layer equations, dimensionless parameters, Reynolds analogy. External forced convection, empirical correlations. Internal flow correlations. Natural convection. Thermal radiation, radiation heat transfer between black bodies, between diffuse gray surfaces, radiation exchange with emitting and absorbing gases.								
Course Objectives	The course is designed to give third year mechanical engineering students the fundamental physics of heat transfer by conduction, convection and radiation. Students are instructed in the analysis and solution of basic heat transfer problems, as supplemented by practical tables, charts and empirical correlations.								
Learning Outcomes and Competences	Understanding of thermal properties and heat transfer mechanisms. Learning the methods used for the analysis of heat transfer problems, and application of these methods for the design and development of thermal systems.								
Textbook and /or Reference	1. Y.A. Çengel, "Heat and Mass Transfer, A Practical Approach", 3 rd Edition, WCB/McGraw-Hill, 2006. 2. F.P. Incropera and D.D. DeWitt, "Fundamentals of Heat and Mass Transfer", 5 th Ed., John Wiley, 2002. 2. V.S. Arpacı, S. Kao and A. Selamet, "Introduction to Heat Transfer", Prentice Hall, 1999.								
Assessment Criteria						If any, mark as (x)		Percentage (%)	
	Midterm Exams					X		40	
	Quizzes					X		10	
	Homeworks					X		10	
	Projects								
	Term Paper								
	Laboratory Work								
	Other								
	Final Exam					X		40	
Instructors	Prof. Senol BASKAYA, Assoc.Prof. Atilla BIYIKOGLU								
Week	Subject								
1	BASICS OF HEAT TRANSFER: Heat transfer mechanisms, conduction, thermal conductivity, convection and radiation, simultaneous heat transfer mechanisms.								
2	HEAT CONDUCTION: General heat conduction equation, boundary and initial conditions, steady one dimensional heat conduction, heat generation in a solid, variable thermal conductivity.								
3	STEADY HEAT CONDUCTION: Steady heat conduction in plane walls, thermal contact resistance, generalized thermal resistance networks, heat conduction in cylinders and spheres.								
4	STEADY HEAT CONDUCTION: Critical radius of insulation, heat transfer from finned surfaces; fin equation, fin efficiency, fin effectiveness. EXPERIMENT I								
5	TRANSIENT HEAT CONDUCTION: Lumped system analysis, transient conduction in large plane walls, long cylinders and spheres, transient conduction in semi-infinite solids and product solutions.								
6	NUMERICAL METHODS IN STEADY CONDUCTION: Finite difference formulation of one-dimensional and two-dimensional steady heat conduction, boundary nodes, irregular boundaries.								
7	NUMERICAL METHODS IN TRANSIENT CONDUCTION: One and two dimensional transient heat conduction, controlling numerical error. MIDTERM EXAMINATION I								
8	FORCED CONVECTION: Fundamentals of convection, classification of fluid flows, velocity boundary layer, thermal boundary layer, laminar and turbulent flows.								
9	FORCED CONVECTION: Derivation of differential convection equations, solutions of convection equations for a flat plate, friction and convection coefficients, and analogies between momentum and heat transfer. EXPERIMENT II								
10	EXTERNAL FORCED CONVECTION: Drag force and heat transfer in external flow, parallel flow over flat plates, flow across cylinders and spheres, flow across tube banks.								
11	INTERNAL FORCED CONVECTION: Mean velocity, mean temperature, the entry region, constant surface heat flux and temperature boundary conditions, laminar flow in tubes, turbulent flow in tubes.								
12	NATURAL CONVECTION: Physical mechanism, natural convection over surfaces, and inside enclosures, combined natural and forced convection. MIDTERM EXAMINATION II								
13	THERMAL RADIATION: Blackbody radiation, radiation intensity, radiative properties, Kirchhoff's law, atmospheric and solar radiation, view factor and view factor relations.								
14	RADIATION HEAT TRANSFER: Radiation heat transfer between black surfaces, between diffuse gray surfaces, radiation shields, radiation exchange with emitting and absorbing gases.								