Faculty of Mechanical Engineering / MECHANICAL ENGINEERING / TRANSFER OF HEAT AND MASS

Course:	TRANSFER OF HEAT AND MASS			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
12197	Mandatory	1	6	3+2+0
Programs	MECHANICAL ENGINEERING			
Prerequisites	No preconditions			
Aims	Students are trained to understand the heat and mass transfer, calculation methodologijes in determining the rate of heat transfer in engineering problems			
Learning outcomes	Upon completing the course, the students will be capable to: 1. Understand the physics of heat transfer mechanisms 2. Able to describe the fundamental and derived physical quantities, know their definitions, which describe the physics of heat transfer; 3. Understand the conservation of energy, mechanical, internal, and total, formulated in the integral form and in the differential form; 4. Able to interpret the causes and dependencies betweeen physical quantities that characterize a specific mechanism of heat transfer; 5. Understand the concept of dimensionless numbers, which quantify the relative intensity of specific physical phenomena and the circumstances under which it is possibly to simplify the problem of heat transfer in terms of its mathematical treatment; 6. Understand the relevant physical terms and the concept of the boundary layer in the context of the convective heat transfer: Newtons law of cooling, coefficient of convection, boundary layer theory, boundary layer thickness, viscous sublayer, separation, coefficient of friction, etc; 7. Understand the effects of turbulence on the mechanism of convective heat transfer and its effects on: boundary layer thickess, the distribution of temperature and velocity, the friction coefficient, pressure drop, separation point, etc., the complexity in determining the intensity of heat transfer by natural and by forced convection in the general case and the modern approaches for its solution; 8. Understand the physics of heat transfer when the phase change of the fluid is involved - boiling and condensation; 9. Understand the heat exchanger typologies and the metodology to calculate the intensity of heat transfer in heat exchangers; 11. Understand the fundamentals of radiative heat transfer and the acompanying physical terms. 12. Understand the calculation of rate of radiative heat transfer between bodies, the classes of problems and the apropriate mathematical approaches in calculating the heat transfer rate through the mechanism of thermal radiation.			
Lecturer / Teaching assistant	Prof. dr Milan Šekularac, vanredni profesor mr Vidosava Vilotijević, dipl.ing.maš, saradnik			
Methodology	Lactures, excercises, homeworks			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Fundamental terms. Thermophyiscal properties of substances recapitulation. Physical mechanisms of heat transfer - main physical characteristics.			
I week exercises	Basic examples and calculations			
II week lectures	Energy equation in integral form. Energy equation in differential form, for the conservation of: total, mechanical, thermal energies. Special cases. Heat conduction - fundamentals. Special cases of 1-dimensional heat conduction			
II week exercises	Calculation examples			
III week lectures	Stacionarna kondukcija toplote. 1D i 2D slučajevi, analitički tretman.			
III week exercises	Stationary heat conduction. 1D and 2D - dimensional cases, analytical treatmen			
IV week lectures	Unsteady conduction. Analytical solutions			
IV week exercises	Calculated examples for stationary and unsteady heat conduction			
V week lectures	Numerical solutions for steady and unsteady conduction			
V week exercises	Calculated examples for unsteady heat conduction			
VI week lectures	Convection. Fundamental terms. Newtons law of cooling. Forced and natural convection. Boundary layer theory.			
VI week exercises	Calculated examples of heat convection			
VII week lectures	Laminar and turbulent boundary layers. Conservation equations for momentum and energy. Coefficients of friction and of heat transfer. Special cases			
VII week exercises	Calculated examples for boundary layers and heat convection			

VIII week lectures	Forced convection. Reynolds analogy. Special cases. Forced convection in straight circular tubes
VIII week exercises	Calculated examples for boundary layers and convection problems
IX week lectures	Natural convection. Boiling and condensation
IX week exercises	Calculated examples for natural convection, annd boiling / condensation heat transfer
X week lectures	Heat excangers
X week exercises	Calculated examples for heat exchangers
XI week lectures	Fundamentals of mass transfer
XI week exercises	Calculated examples for mass transfer
XII week lectures	Fundamentals of thermal radiation
XII week exercises	Basic calculated examples for thermal radiation - fundamental terms, definitions, view factors
XIII week lectures	Fundamentals of calculating rate of radiative heat transfer. Special cases of grey bodies separated by a transparent medium. Fundamentals of radiative heat transfer in participating media.
XIII week exercises	Calculated examples for raditive heat transfer calculation between grey surfaces separated by a nonparticipating media.
XIV week lectures	
XIV week exercises	
XV week lectures	
XV week exercises	
Student workload	Written test Final exam test Seminar - homeworks

Per week	**Per semester**
6 credits x 40/30=8 hours and 0 minuts 3 sat(a) theoretical classes 0 sat(a) practical classes 2 excercises **3 hour(s) i 0 minuts** of independent work, including consultations	Classes and final exam: **8 hour(s) i 0 minuts x 16 =128 hour(s) i 0 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **8 hour(s) i 0 minuts x 2 =16 hour(s) i 0 minuts** Total workload for the subject: **6 x 30=180 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **36 hour(s) i 0 minuts** Workload structure: **128 hour(s) i 0 minuts (cources), 16 hour(s) i 0 minuts (preparation), 36 hour(s) i 0 minuts (additional work)**
Student obligations	Weekly 6 credits x x 40/30 = 8 hours Structure: 3 hours of lecture, 2 hours of excercises, 3hours of individual work, with consultations During semester Classess plus final exam: (8 hours) x 16 = 128 h Required preparatory works (administrationa, enrollment, etc): 2 x (8 hati) = 16 h Total load for the course: 6x30 = 180 h Extra work: 36 h to prepare the exam in the auxiliary term, includint the conduction of the 2. test 128 h (Lectures)+16 h (Preparatory work)+36 h (Extra work)
Consultations	
Literature	1. Skripta Prenos toplote i mase, autor Prof.dr Petar Vukoslavčević 2. F. Incroppera, Fundamentals of heat and mass transfer 3. Schaums Outlines Series, McGraw Hill, Heat transfer 4. F.Incroppera, Solutions manual 5. Slajdovi sa nastave 6. Kozić i dr, Zbirka zadataka iz prenošenja toplote, Mašinski fakultet Beograd
Examination methods	
Special remarks	
Comment	

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points