САМАРСКИЙ ПОЛИТЕХ
Опорный университет

МИНОБРНАУКИ РОССИИ

Федеральное государственное бюджетное образовательное учреждение высшего образования «Самарский государственный технический университет» (ФГБОУ ВО «СамГТУ»)

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Приложение 1

ПРОГРАММА
Международного обучающего семинара
«Simulation, design and optimization of electrotechnological equipment and systems»

(9 - 12 октября 2017, место проведения семинара: г. Самара, ул. Галактионовская, 141, 6 корпус, Самарский государственный технический университет)

Рабочий язык семинара – английский

Открытые лекции (общая часть курса)

№	Тема (Subject)	Количество часов (hours)	Преподаватель (lecturer)	Наименование университета (University)
1	Fundamentals of induction heating	2	Профессор, директор института **Бернард Наке** (Prof. Dr.-Ing. Bernard Nacke)	Институт электротехнологий, Ганноверский университет им. Лейбница, г. Ганновер, Германия (Institute of Electrotechnology, Leibniz University Hannover)
2	Applications of induction heating	4		
3	Methods for design and optimisation of induction heating	2		
4	Fundamentals and applications of induction melting processes	2	Профессор **Эгберт Бааке** (Prof. Dr.-Ing. Egbert Baake)	Институт электротехнологий, Ганноверский университет им. Лейбница, г. Ганновер, Германия (Institute of Electrotechnology, Leibniz University Hannover)
5	Electromagnetic levitation melting	2		
6	Applications of cold crucible induction furnace	2		

7	Energy saving and reduction of CO_2 emission of industrial thermal processes	2		
8	Basics of thermal phenomena description (thermal conduction, convection and radiation, equations and additional conditions, characteristic numbers, simple examples) Basics of incompressible flow phenomena description (laminar and turbulent flow, equations and additional conditions, characteristic numbers, simplified description of turbulence (two parameter models, LES,…), examples of numerical solutions)	2	Профессор **Андрис Якович** (Prof. Dr. Phys. Andris Jakovičs)	Латвийский университет, г. Рига, Латвия (University of Latvia)
9	Basics of mass exchange phenomena description (diffusion and convection, equations and additional conditions, characteristic numbers, simple examples). Specific approaches by numerical simulation of flow phenomena (conservation of mass, SIMPLE and PISO algorithms and modifications, Lattice Boltzmann method, examples of numerical modelling).	2		
10	Coupled electromagnetic and flow phenomena description (implementation of Joule heat and Lorenz force, phase boundaries movement, reverse impact of flow to the electromagnetic field, examples of numerical modelling)	2		
11	Application of numerical modelling for different technological processes: - Crucible and channel induction furnaces; - Cold crucible furnace and levitation; - EM induction pump for liquid metals; - Rotating magnets for pumping and mixing of metals; - Two-phase liquid metal flows with particles and bubbles in EM field; - Electromagnetic casting.	2		
	Всего	24		

Мастер-класс ANSYS (часть курса по выбору)

«Numerical simulation of electromagnetic and thermal fields in systems of induction heating using multi-physics engineering software ANSYS»

№	Тема (Subject)	Количество часов (hours)	Преподаватель (lecturer)	Наименование университета (University)
1	Heat conduction equation. System of equation for electromagnetic field. General form transformation of equation system for electromagnetic field to solve stationary and non-stationary problems. Definition of magnetic vector potential. Energy functional.	2	Доцент, к.т.н. **Игорь Владимирович Позняк**	Западночешский университет г. Пльзень, Чехия (University of West Bohemia)
2	Key features of ANSYS/Maxwell software. Main terms and definitions. Structure of graphic user interface (GUI). Stages of problem solution. Basic concepts of finite difference method and finite element method (FEM).	2		
3	Types and classification of finite elements in ANSYS. Algorithms and parameters for the development of FEM models in 2D and 3D problems. Development of geometrical models in ANSYS pre-processor. Development of models of materials.	2		
4	Types and methods of definition of boundary conditions. Problem solver for system of linear equations.	1		
5	Adjustment of ANSYS/Maxwell interface. Development of data base for the materials. Graphical model building. Introduction into APDL language.	2		
6	Solution of 2D – 3D problems for electromagnetic field (harmonic analysis). Determination of parameters of induction heating system.	7		
	Total hours	16		

Мастер-класс FLUX (часть курса по выбору)

«Numerical simulation of electromagnetic and thermal fields in systems of induction heating using problem-oriented software FLUX»

№	Тема (Subject)	Количество часов (hours)	Преподаватель (lecturer)	Наименование университета (University)
1	INTRODUCTION TO FLUX: basic structure of the software: preprocessor, physics, postprocessor. Solvers available: Magnetic (Static, Sinusoidal, Transient), Electric (Static, Conduction, Sinusoidal) and Thermal (static and transient)	2	Профессор **Микеле Форцан** (Prof. Dr.-Ing. Michele Forzan)	Падуанский университет, г. Падуя, Италия (Università degli Studi di Padova)
2	DEFINITION OF A SIMPLE 2D EDDY CURRENT PROBLEM. Construction of the geometry and mesh. Circuit coupling.	2		
3	MATERIAL DATA BASE. Relevant properties for magnetic, electric and thermal problems. Non linear magnetic permeability. Temperature dependance.	2		
4	SOLVER. Different solvers available in Flux. PARAMETRIC SOLVERS applied to the Solution of the 2D eddy current problem. Basic PostProcessing.	2		
5	Basic treatment about multi-objective optimization problem. Coupling between Flux and FGOT (a free optimization tool). Optimal solutions of the proposed 2D model.	2		
6	Analysis of results of optimization and parametric solution. Proposal of a simple problem of EM levitation: students have to solve the proposed problem.	2		
7	Basic information regarding the construction of a 3D model: geometry and mesh strategies.	2		
8	Creation of a simple eddy current (sinusoidal) 3D model. Mesh. Physical properties.	1		
9	Preparation of the models to be solved with different numerical formulations (the treatment of the formulations will be done the next day to have the possibility to have the solutions of the problem in time).	1		
	Всего	16		