

PROGRAMA DE CURSO

Código	Nombre			
MA5507	Modelamiento Matemático Multiescala en Ingeniería, Biología y Medicina			
Nombre en Inglés				
Multi-scale mathematical modeling in engineering, biology and medicine				
SCT	Unidades Docentes	Horas de Cátedra	Horas Docencia Auxiliar	Horas de Trabajo Personal
6	10	3	2	5
Requisitos			Carácter del Curso	
MA4801 Análisis Funcional			Electivo de Carrera, Magister y Doctorado	
Resultados de Aprendizaje				
<ol style="list-style-type: none"> 1. Introduction to the main equations of mathematical physics used in the mathematical modeling of boundary-valued and time dependent problems. <ul style="list-style-type: none"> -Diffusion-convection equation 2. Models of flows. Thin tube structures and multistructures. Asymptotic analysis. Reynolds's equations on the graph. Method of partial asymptotic decomposition of the domain for flows in a tube structure with rigid walls. 3. Modeling of composite materials and meta-materials. Homogenization technique in mechanics of solids: passage from microscopic scale to the macroscopic scale. 				

Metodología Docente	Evaluación General
<ul style="list-style-type: none"> • Clase expositiva 	<ul style="list-style-type: none"> • Control X

Unidades Temáticas

Número	Nombre de la Unidad	Duración en Semanas
1	Introduction to the main equations of mathematical physics	7
Contenidos	Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
<ul style="list-style-type: none"> - Diffusion-convection equation - Viscous flows equations (Navier-Stokes equations, Stokes equations, non-newtonian flows) - Elasticity equations, visco-elasticity equations - Dirichlet's, Neumann's, Robin's and periodic boundary conditions; number of initial conditions; periodic in time problems - Derivation from physic laws (ideas) and notion of mathematical analysis (variational formulation, existence, uniqueness and stability of the solution, i.e. well-posedness). - Numerical methods: finite elements, difference schemes. 	<p>Practical use of the main equations of mathematical physics in modeling boundary-valued and time dependent problems.</p>	<p>[7] Chapter 2 [9] all of the chapters</p>

Número	Nombre de la Unidad	Duración en Semanas
2	Models of flows	3
Contenidos	Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
<ul style="list-style-type: none"> - Thin tube structures and multi-structures. Asymptotic analysis. - Reynolds's equations on the 	<p>Practical use of the main equations of mathematical physics in modeling boundary-valued and time dependent</p>	<p>[3], [8]</p>

graph. Method of partial asymptotic decomposition of the domain for flows in a tube structure with rigid walls.	problems.	
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Número	Nombre de la Unidad	Duración en Semanas
3	Modeling of composite materials and meta-materials.	5
Contenidos	Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
- Homogenization technique in mechanics of solids: passage from microscopic scale to the macroscopic scale.	Practical use of the main equations of mathematical physics in modeling boundary-valued and time dependent problems.	[1], [2], [3], [4-5], [8]

Bibliografía General

- [1] N.S. Bakhvalov, G.P. Panasenko. Homogenization: Averaging Processes in Periodic Media, Moscow: Nauka, 1984; English translation: Dordrecht etc.: Kluwer, 1989.
- [2] A. Bensoussan, J.L. Lions, and G. Papanicolaou. Asymptotic Analysis for Periodic Structures. Amsterdam: North-Holland, 1978.
- [3] C. Conca, Problèmes Mathématiques en Couplage Fluide-Structure, Eyrolles, Paris, 1994.

- [4] V.V. Jikov, S.M. Kozlov, O. A. Oleinik. Homogenization of Partial Differential Operators and Integral Functionals, Berlin-New York: Springer-Verlag , 1994.
- [5] O.A. Oleinik, A.S. Shamaev, and G.A. Yosif'yan. Mathematical Problems in Elasticity and Homogenization. Amsterdam:Elsevier , 1992.
- [6] G.P. Panasenko. Multi-scale Modeling for Structures and Composites, Springer, 2005.
- [7] G. Panasenko , K. Pileckas , Asymptotic analysis of the non-steady Navier-Stokes equations in a tube structure.I. The case without boundary layer-in-time. Nonlinear Analysis, Series A, Theory, Methods and Applications, 122, 2015, 125-168, <http://dx.doi.org/10.1016/j.na.2015.03.008> II. General case. Nonlinear Analysis, Series A, Theory, Methods and Applications, 125, 2015, 582-607, <http://dx.doi.org/10.1016/j.na.2015.05.018>
- [8] E. Sanchez-Palencia. Nonhomogeneous Media and Vibration Theory. New York: Springer-Verlag, 1980. Russian translation: Moscow, Mir, 1984.
- [9] A.N.Tikhonov, A.A.Samarskii. Equations of Mathematical Physics, Oxford, 1963

Vigencia desde:	September, 2016
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