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
	10	3	2	5

Requisitos	Carácter del Curso
MA4801 Análisis Funcional	Electivo de Carrera, Magister y Doctorado

Resultados de Aprendizaje

1. Introduction to the main equations of mathematical physics used in the mathematical modeling of boundary-valued and time dependent problems. -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
• Clase expositiva	• 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
- 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-possedness). - Numerical methods: finite elements, difference schemes.	Practical use of the main equations of mathematical physics in modeling boundary-valued and time dependent problems.	[7] Chapter 2 [9] all of the chapters

Número	Nombre de la Unidad	Duración en Semanas
2	Models of flows	3

Contenidos	Resultados de Aprendizajes de la Unidad	Referencias a la Bibliografía
- Thin tube structures and multi-structures. Asymptotic analysis. - Reynolds's equations on the	Practical use of the main equations of mathematical physics in modeling boundary-valued and time dependent	[3], [8]

graph. Method of partial asymptotic decomposition of the domain for flows in a tube structure with rigid walls.	problems.	

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 Mathèmatiques 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
Elaborado por:	Prof. Grigory Panasenko
Revisado por:	Prof. Carlos Conca