Academic subject: Elements of Advanced Mathematical Physics				
Degree Class: LM-40 – Matematica		**Degree Course:** Mathematics	**Academic Year:** 2020/2021	
		Kind of class: optional	**Year:**	**Period:** 1
			ECTS:7 divided into **ECTS lessons**: 6,5 **ECTS exe/lab/tutor:** 0,5	
Time management, hours, in–class study hours, out–of–class study hours lesson: 52 exe/lab/tutor: 8 in–class study: 60 out–of–class study: 115				
Language: Italian	**Compulsory Attendance:** no			
Subject Teacher: Lidia R. R. Palese	**Tel:** **e–mail:** lidiarosaria.palese@uniba.it	**Office:** Department of Mathematics Room 29, II Floor	**Office days and hours:** Wednesday 11-13. Friday 11-13 Other days and times by appointment.	
Prerequisites: Mathematical knowledge which usually is acquired during the three years of a degree of L–35 class.				
Educational objectives: Acquiring language and techniques of mathematical physics, especially of theory of mathematical modeling, hydrodynamic stability theory, existence of linearization principles..				

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<td>Expected learning outcomes (according to Dublin Descriptors)</td>
<td>Knowledge and understanding:
Acquiring fundamental concepts in mathematical physics and of mathematical modeling. Acquiring mathematical proof techniques.

Applying knowledge and understanding:

Ability to use theoretical knowledge in various dynamical problems.

Making judgements:

Ability to identify mathematical tools and techniques to study physical problems written as mathematical models.

Communication:

Students should acquire the mathematical language and formalism necessary to read and comprehend mathematical models, to explain the acquired knowledge .

Lifelong learning skills:

Acquiring suitable learning methods, supported by text consultation and by solving the questions periodically suggested during the course.</td>
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<td colspan="2">Course program

Elements of spectral theory of linear operators in normed spaces: resolvent and spectrum. Multiplicity and rank . Spectral properties of some classes of linear operators in Hilbert spaces.

Elements of variational calculus: linear and continuous functionals. Maximum and minimum value of a functional. Variation of a functional. Euler equations. Isoperimetric problems.

Setting of the problem of the motion for a continuous system: the constitutive equations. The Cauchy-Poisson constitutive equation.

Setting of the problem of classical hydrodinamic stability . Classical solutions of the Navier Stokes equations. Stability in the small. Stability in the mean. Eigenvalue problems of linear stability.

Classical solutions of the Navier-Stokes equations: Couette, Poiseuille and Couette-Poiseuille motions. The di Orr-Sommerfeld equation. Rayleigh e di Squire theorems. Global and conditional stability. Actractivity. Serrin criteria of hydrodynamic stability.

Generalized solutions in hydrodynamic stability: generalized solutions of linear and nonlinear problems. Motions in bounded domains. Turbulent solutions and strong solutions of the nonlinear problem. The linear problem. Completeness of normal modes perturbations. The linearization principle in hydrodynamic stability. The stability of the Couette plane motion. The principle of exchange of stabilities.

The Bénard problem: setting of the problem. Linearized Bénard problem near the thermodiffusive equilibrium. Proof of the principle of exchange of stabilities for the Bénard problem with the definite integrals method. Exact solutions of the eigenvalue problem governing linear stability for particular boundary conditions. Linear stability and detection</td>
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of the Rayleigh function. Critical Rayleigh number of the linear stability. Solution of the linear stability problem with the direct Chandrasekhar Galerkin method.

Teaching methods:

Lectures and exercise sessions.

Auxiliary teaching:

Didactic material provided by the teacher.

Assessment methods:

Oral exam.

Bibliography:

A. Georgescu : Hydrodynamic Stability theory, Kluwer, 1985.
S. Chandrasekhar: Hydrodynamic and Hydromagnetic Stability, Clarendon Press, Oxford, 1968.
S. G. Mikhlin: Mathematical Physics, an advanced course, North Holland, 1970.