DIPARTIMENTO DI SCIENZE

COURSE: **RESERVOIR MODELLING**			
ACADEMIC YEAR: **2019-2020**			
TYPE OF EDUCATIONAL ACTIVITY: **Affine**			
TEACHER: **Dr. Marilena Pannone**			
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phone: **0971-205147**		mobile (optional):	
Language: **ENGLISH**			
ECTS: **6 (4 lessons and tutorials/2 practice)**	n. of hours: **56 (32 lessons and tutorials/24 practice)**	Campus: **Potenza** Dept./School: **Department of Sciences** Program: **Master in Geosciences and Georesources**	Semester: 1st

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The course aims at presenting mathematical methodologies that are useful in the study of fluid flow and transport in heterogeneous porous formations/reservoirs. It will resort to the use of Fourier-spectral methods, analytical linearization techniques, method of spatial moments, transport Eulerian-Lagrangian approach, stochastic analysis and geostatistics.

The expected learning outcomes consist in the capability to apply these methodologies for the understanding, the prediction, the monitoring and the control of the phenomena that characterize flow and transport in heterogeneous geologic formations at local and regional scale. This capability will be acquired by applications to worked-out examples, a project work, and the discussion of scientific review papers.

PRE-REQUIREMENTS

Basic-level Mathematics, Physics and Geology.

SYLLABUS

- **Review of Fourier methods for readers who have had the standard series of calculus. Review of the basics of stochastic processes and geostatistics (6h lessons and tutorials/4h practice).**
- **Derivation of head and velocity covariance functions from the covariance function of the logarithm of the hydraulic conductivity. The analytical and numerical methods presented in this part are also useful for the derivation of the statistics of other quantities. Emphasis is on small-variance (linearized) cases and analytical and semi-analytical solutions. Determination of effective macroscopic parameters of microscopically heterogeneous media. We will focus on the determination of effective conductivities and effective dispersion coefficients. We will use a powerful unified approach based on a generalization of Taylor-Aris dispersion theory. We will also use the method of multiple scales (10h lessons and tutorials/8h practice).**
- **Introduction to Lagrangian methods ("particle tracking"), which relate macroscopic transport parameters to the probabilistic properties of an appropriately chosen particle or set of particles (8h lessons and tutorials/6h practice).**
- **Analysis of selected numerical methods. We will focus on Monte Carlos simulations, numerical spectral methods and discrete Fourier transforms (8h lessons and tutorials/6h practice).**

TEACHING METHODS

Theoretical lessons and classroom tutorials will be complemented with reading assignments from research papers and with a project work.

EVALUATION METHODS

Theoretical examination and discussion of the project work.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Dagan, G.: Flow and transport in porous media, Springer-Verlag, 1989.

Kitanidis, P.K.: Introduction to Geostatistics: Application in Hydrogeology, Cambridge University Press, 1997.

Brown, J.W. and Churchill, R.V.: Fourier series and boundary value problems, McGraw-Hill, 2011.

Notes, research papers and other material provided by the teacher.

INTERACTION WITH STUDENTS

The course will be fully held in Potenza. Students can also interact with the teacher by e-mail or during weekly office hours.

EXAMINATION SESSIONS (FORECAST)[1]

February, 20 2020; March, 19 2020; June, 19 2020; July, 16 2020; September, 18 2020; October, 16 2020; December, 11 2020.

SEMINARS BY EXTERNAL EXPERTS YES □ NO **X**

FURTHER INFORMATION

[1]Subject to possible changes: check the web site of the Teacher or the Department/School for updates.