General course information:

Course title:	**Hydrologic Modeling and Forecasting**	**Course code:**	ΥΔ0620
Credits:	5	**Work load (hours):**	140
Course level:	Undergraduate ☑	Graduate ☐	
Course type:	Mandatory ☐	Selective ☑	
Course category:	Basic ☐	Orientation ☑	
Semester:	8th	**Hours per week:**	4

Course objectives (capabilities pursued and learning results):

Scope of the course is the introduction and the understanding of hydrological models of surface hydrology and the hydrological simulation and forecasting, methods of stochastic hydrology and stochastic processes in hydrology, analysis and simulation of hydrological timeseries, analysis and simulation of extreme hydrological design values and the understanding of the processes of surface hydrology.

This course strengthens students' technical and intellectual competency, preparing them for engineering employment or advanced study. The course exposes students to methodologies of deterministic and stochastic hydrologic simulation and the methodologies of computation of hydrologic design values, which are used in modern professional civil engineering practice.

Upon completion of the course, students should be able to demonstrate:

- Knowledge and understanding of the natural processes of snow hydrology
- Knowledge and understanding of natural processes of drought
- Ability to apply deterministic models for the hydrologic simulation and design
- Ability to estimate the spatial distribution of hydrological and hydrometerological data with deterministic, geostatistical, combinational and hybrid methodologies
- Ability to apply methodologies and models for the analysis and simulation of hydrological timeseries
- Ability to apply methodologies of hydrological forecasting
- Ability to apply methods and techniques of regional analysis for the hydrological design with limited or without data
- Ability to compute extreme hydrological values for the design of safety hydraulic works

Prerequisites:

Hydrology
Probability - Statistics

Instructor's data:

Name:	Lampros Vasiliades
Level:	Dr.
Office:	
Tel. – email:	+302421074115 – lvassil@civ.uth.gr
Other tutors:	

Specific course information:

Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
1	• Introduction. Mathematical models of rain-runoff. Classification of models. Presentation of hydrological models.	**4**	**2**
2	• Presentation and application of hydrological models. Calibration of parametric deterministic hydrological models. Trial-and-Error and automatic calibration and validation of hydrological models.	**4**	**2**
3	• Systems of hydrological simulation of large river basins. Hydrological and hydraulic methods of flow routing. Coupling of hydrological models with flow routing models.	**4**	**2**
4	• Analysis of hydrological timeseries. Structure and characteristics of hydrological timeseries. Deterministic and stochastic components of timeseries. • Methods of timeseries analysis. Methods of timeseries stationarity.	**4**	**2**
5	• Stochastic models of timeseries. Stochastic models of one variable. Autoregressive model AR(q). Moving average model MA(q). Combined models (autoregressive moving average) ARMA (p,q). Models of periodic timeseries.	**4**	**2**
6	• Stochastic models of timeseries. Stochastic models of one variable. Autoregressive model AR(q). Moving average model MA(q). Combined models (autoregressive moving average) ARMA (p,q). Models of periodic timeseries.	**4**	**2**

7	• Stochastic models of two variables. Model of the noise transfer function. Kalman filter. Markov chains.	**4**	**2**
8	• Hydrological forecasting. Short term and long term forecasting. Deterministic and stochastic forecasting. Nowcasting.	**4**	**2**
9	• Estimation of spatial distribution of hydrometeorological data. Deterministic (trend surfaces, regression, inverse distance weighting, splines) and geostatistical methods (ordinary and universal kriging)	**4**	**2**
10	• Estimation of spatial distribution of hydrometeorological data. Geostatistical and combinational methods (resi-dual geostatistics και residual inverse distance weighting).	**4**	**2**
11	• Use of Geographical Information Systems in hydrologic modelling. Estimation of watersheds and geomorphologic parameters with the use of GIS.	**4**	**2**
12	• Introduction to semi-distributed and distributed hydrologic model. Snow hydrology. Snow energy balance. Natural processes of snow runoff.	**4**	**2**
13	• Introduction to hydrological model uncertainty	**4**	**2**
14	• Summary and theory revision - Concluding remarks	**4**	**2**

Additional hours for:			
Class project	**Examinations**	**Preparation for examinations**	**Educational visit**
56			

Suggested literature:

Greek Bibliography:

Mimikou, M., 2006. «Technology of Water Resources», 3rd Ed, Papasotiriou & Sia Publications, ISBN: 978-960-7530-79-0. [in Greek]

Tsakiris, G., 2012. «Water Resources I. Engineering Hydrology», Symmetria Publications, ISBN: 978-960-266-380-6. [in Greek]

English Bibliography:

Abrahart, R.J., L.M. See, and D.P. Solomatine, (eds.) 2008. Practical Hydroinformatics: Computational Intelligence and Technological Developments in Water Applications, Springer-Verlag, Berlin.

Anderson, M.G., and J.J. McDonnell, (eds.) 2005. Encyclopedia of Hydrological Sciences, Wiley Publications.

Beven, K.J., 2012. Rainfall-Runoff Modelling: The Primer, 2nd Edition, Wiley-Blackwell.

Box, G.E.P., G.M. Jenkins, and G.C. Reinsel, 2008. Time Series Analysis: Forecasting and Control. 4th Edition, John Wiley & Sons.

Cryer, J.D. and K.-S. Chan, 2008. Time Series Analysis: With Applications in R. 2nd Edition, Springer Publications.

Karamouz, M., Nazif, S., Falahi, M., 2013. Hydrology and Hydroclimatology: Principles and Applications. CRC Press.

Maidment, D.R., (ed.) 1993. Handbook of Hydrology. McGraw-Hill.

Makridakis, S., S., Wheelwright, and R.J. Hyndman, 1998. Forecasting: Methods And Applications. 3rd Edition, John Wiley & Sons.

Mimikou, M., Baltas, E. and Tsihrintzis, V., 2016. Hydrology and Water Resources System Analysis, July 2016, Textbook – 448 Pages – 208 B/W Illustrations, ISBN 9781466581302, CRC Press, Taylor and Francis Group.

Ramachandra Rao, A., and K.H. Hamed, 2000. Flood frequency analysis, CRC Press.

Sene, K., 2008. Flood Warning, Forecasting and Emergency Response, Springer Publications.

Sene, K., 2010. Hydrometeorology: Forecasting and Applications, Springer Publications.

Shumway, R.H. and D.S. Stoffer, 2011. Time Series Analysis and Its Applications: With R Examples. 3rd Edition, Springer Publications.

Teaching method *(select and describe if necessary* - **weight***):*		
Teaching	☑	60%
Seminars	☐	…….%
Demonstrations	☐	…….%
Laboratory	☑	20%
Exercises	☑	20%

Visits at facilities	☐	…….%
Other *(describe):* …….	☐	…….%
Total		100%

Evaluation method *(select)*- **weight:**				
	written	*%*	*Oral*	*%*
Homework	☐		☐	
Class project	☑	80	☑	20
Interim examination	☐		☐	
Final examinations	☐		☐	
Other *(describe):* ……	☐		☐	