SCUOLA	Scienze giuridiche ed economico sociali
ANNO ACCADEMICO	2014/2015
CORSO DI LAUREA MAGISTRALE	SVILUPPO SOSTENIBILE DELLE ORGANIZZAZIONI PUBBLICHE E PRIVATE
INSEGNAMENTO	Model-based analysis and policy design
TIPO DI ATTIVITÀ	A scelta
AMBITO DISCIPLINARE	A scelta
CODICE INSEGNAMENTO	14130
ARTICOLAZIONE IN MODULI	no
NUMERO MODULI	
SETTORI SCIENTIFICO DISCIPLINARI	MAT/09
DOCENTE RESPONSABILE	Erling Moxnes PO University of Bergen
CFU	10
NUMERO DI ORE RISERVATE ALLO STUDIO PERSONALE	180
NUMERO DI ORE RISERVATE ALLE ATTIVITÀ DIDATTICHE ASSISTITE	70
PROPEDEUTICITÀ	Nessuna
ANNO DI CORSO	I
SEDE DI SVOLGIMENTO DELLE LEZIONI	http://www.uib.no/en/course/GEO-SD303
ORGANIZZAZIONE DELLA DIDATTICA	Lezioni frontali, Esercitazioni in aula, Esercitazioni in aula informatica, redazione di un progetto. Introduction to System Dynamics analysis of non-linear, dynamic systems with emphasis on the relationship between system structure and behaviour, and on policy design and implementation. Level: graduate; 10 ECTS points. The course is conducted entirely in English. The course is comprised of lectures on introductory material and case studies, and of classroom modelling and simulation activities both by lecturer and teaching assistant and is completed by a four hour written exam. The course requires a Bachelor’s degree in any subject. The course is open to students enrolled in the Erasmus Mundus master program and to graduate and undergraduate students at the University of Bergen.
MODALITÀ DI FREQUENZA	Obbligatoria
METODI DI VALUTAZIONE	Prova Scritta, Presentazione di un progetto Assessment is carried out by means of evaluation of individual assignment/s and an exam. To sit for the exam, the student must have pass marks on all the assignments. An ECTS grade is provided to the student at the end of the

	course according to the A─F scale. Students not successfully fulfilling all the course requirements within the regular time frame have the option of a re-sit once the following semester.
TIPO DI VALUTAZIONE	Voto in trentesimi
PERIODO DELLE LEZIONI	Primo semestre
CALENDARIO DELLE ATTIVITÀ DIDATTICHE	http://www.uib.no/en/course/GEO-SD303
ORARIO DI RICEVIMENTO DEGLI STUDENTI	http://www.uib.no/en/course/GEO-SD303

OBIETTIVI FORMATIVI

This is an introduction to System Dynamics analysis of non-linear, dynamic systems with emphasis on the relationship between system structure and behaviour, and on policy design and implementation. Students learn to build, simulate and test models of social, natural and hybrid systems, to analyze the structural causes of problem behavior and to develop and evaluate policies aimed at addressing such problems. The students gain a deep understanding of the intimate relationship between structure and behaviour in complex, dynamic systems; how structure gives rise to behavior and how the resulting behaviour may feed back to change the relative significance of the structural components of the system. This enables the students to analyze problems and to develop and evaluate policies of their own choice. The students also learn to distil the essence of a modelling experience and to communicate their analysis and design conclusions in the form of a compact executive summary.

OBIETTIVI DI APPRENDIMENTO ATTESI

Knowledge and understanding

Students gain extended knowledge about the System Dynamics method with particular emphasis on model based problem identification and analysis as well as hypothesis formulation and analysis in policy design. They also get to know about the intimate relationship that exists between structure and behaviour (dynamics) in non-linear systems and the shifts in causal loop governance that may take place in such systems. They obtain knowledge about the significance of a robust strategy development, the associated policy design and the resulting decision making (i.e management). The students will know of the basic concepts of systems dynamics theory, methods, techniques and tools.

Applying knowledge and understanding

Students will apply their knowledge in a series of comprehensive case studies that will be presented in class. Students are challenged to investigate the turbulent dynamics arising from an underlying, non-linear structure by way of computer based modelling and simulation. Particular emphasis will be placed on their recognition of dynamic patterns of problem behaviour and the corresponding underlying structures, as well as their ability to propose and evaluate policies to address such problems. Students are trained to distil the essence of their insights and present it in the form of compact causal loop diagrams.

Making judgements

Students learn to make judgements about both how well a model structure contributes to the explanation of an observed or hypothesised dynamic behaviour.

Communication

Students are encouraged to and do participate actively in class. The students will be trained both in writing and in oral presentations to explain the relationship between structure and dynamic behaviour in non-linear systems.

Learning skills

The course is putting the student on the track of becoming a skilled modeller, a problem identifier and a policy designer. It equips the student with the basic skills and tools to progress in the investigation of systems in ever more complex domains and familiarise the student with relevant scientific literature in the field.

ORE	LEZIONI FRONTALI
5	Introduction to complex, dynamic structures and their associated dynamic behaviour
5	Principles of simulation (of discreet and continuous systems)
5	Modelling non-linearity, accumulation and delays
5	Modelling the formation of expectations
5	Knowledge distillation and presentation
5	System dynamics analysis, policy design and the concept of robustness
5	Link and loop gains and endogenous shifts in structural governance
5	Model analogies and transparency
	ESERCITAZIONI
30	• Case 1: Mr. Wang repair shop (capacity constraints as origin of oscillations) • Case 2: The Beer Game (misperceptions along a supply chain as origin of oscillations) • Case 3: The Tragedy of the Commons (population) Model • Case 4: The Urban Dynamics Model • Case 5: The Market Growth Model • Case 6: The Commodity Market model • Case 7: The Petroleum Life Cycle Model • Case 8: The World Dynamics Model • Case 9: The Romeo and Juliet Model • Case 10: The Disease Diffusion Model • Case 11: The Predator Prey (Lotka – Volterra) Model • Case 12: The Human Resource Model • Case 13: The Workers Burnout Model • Case 14: The Technology model
TESTI CONSIGLIATI	Basic reading list (more specific references will be provided in the introductory session): Andersen, D.F. (1980). How Differences In Analytic Paradigms Can Lead To Differences In Policy Conclusions. In J. Randers (ed.), Elements of the System Dynamics Method. (pp 23-57). Cambridge MA: MIT Press. Goodman, Michael R. (1989). *Study Notes in System Dynamics*. Pegasus Communications (original version published by MIT Press, 1989). Chapter 1 – 4, Exercise 4 – 12. Davidsen, P.I. (1992). The Structure-Behavior Graph. Understanding the relationship between structure and behavior in complex, dynamic systems. in *Proceedings of the 10th System Dynamics Conference*, Utrecht, 1992, System Dynamics Society, Albany, N.Y.. Davidsen, P.I., Sterman, J. D., Richardson, G.P. (1990). A Petroleum Life Cycle Model for the United States with

Endogenous Technology, Exploration, Recovery, and Demand, System Dynamics Review, 6,1 (Winter 1990), pp. 66 – 93, J. Wiley & Sons.

Forrester, J.W. (1956). Dynamic Models of Economic Systems and Industrial Oranizations. Note to the Faculty Research Seminar, D-0000, Sloan School of Management, MIT.

Forrester, J.W. (1980). System Dynamics – Future Opportunities. In Legasto, A., J.W. Forrester and J. Lyneis (eds.) System Dynamics TIMS Studies in Management Sciences 14. New York: North Holland.

Forrester, J.W. (1968). Market growth as influenced by capital investment, Industrial Management Review 9(2), 83 - 105.

Forrester, J.W. (1971). Counterintuitive behavior of social systems, Technology review 73(3), 52 - 68.

Forrester, J.W (1992). Policies, decisions and information sources for modeling. European Journal of Operational Research 59(1), 42 - 63.

Hamilton, M.S. (1980). Estimating Length an Orders of Delays In System Dynamics Models. In J. Randers (ed.), Elements of the System Dynamics Method. (pp 23-57). Cambridge MA: MIT Press

Lane, David C. (2008). The Power of the Bond Between Cause and Effect: Jay Wright Forrester and the Field of System, System Dynamics Review 23 (2-3).

Low, G.W. (1980): The Multiplyer Accellerator Model of Byusiness Cycles Interpreted from a System Dynamics Perspective. In J. Randers (ed.), Elements of the System Dynamics Method. (pp 23-57). Cambridge MA: MIT Press

Meadows, D.H. (1980). The Unavoidable A Priori. In J. Randers (ed.), *Elements of the System Dynamics Method. (*pp 23-57). Cambridge MA: MIT Press.

Richardson, G.P. (1986). Loop Polarity, Loop dominance and the concept of dominant polarity, System Dynamics Review 11(1), 67 - 88.

Richardson, G.P. (1986). Problems with causal loop diagrams, System Dynamics Review 2(2), 158 - 170.

Richardson, G.P. (1986). Problems with causal loop diagrams revisited, System Dynamics Review 13(3), 247 - 252.

Sterman, J.D. (1987). Expectation Formation in Behavioral Simulation Models, Behavioral Science 32, 190 - 211.

Sterman, J.D. (1988). Modeling the Formation of Expectations: The history of Energy Demand Forecasts, International Journal of Forcasting 4, 243 - 259.

Sterman, J.D. (1988). "A Skeptic's Guide to Computer Models.", In Grant, L., Foresight and National Decisions. Lanham, MD: University Press of America, 133-169.

Sterman, J.D., Richardson, G.P. and Davidsen, P.I (1988).: Modeling the estimation of petroleum resources in the United State, Technological Forecasting and Social Change 33(3), 219-249.

Sterman, J.D. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World.* Boston: Irwin/McGraw-Hill, Chapters 9, 11 to 20.

	Suggested readings: Warren, Kim: Strategic Management Dynamics, 2008, John Wiley & Sons, Ltd. (private sector applications) Ford, Andrew: Modeling the environment, 2009 (second edition), Island Press. (public sector applications) Lecture notes by Pål I. Davidsen: The Structure Behavior Graph ¨ Counterintuitive Behavior and Policy Design. Case studies and Lecture Notes in System Dynamics Course meetings include 36 lecture hours and 18 hours of lab assistance over a 6-7 week period (two lectures and one lab per week) from mid-August until the mid-October. The exam is in the middle of December.