ADVANCED SIMULATION TECHNIQUES

1	Course Title:	ADVANCED SIMULATION TECHNIQUES	
2	Course Code:	END 6112	
3	Type of Course:	Compulsory	
4	Level of Course:	Third Cycle	
5	Year of Study:	2	
6	Semester:	4	
7	ECTS Credits Allocated:	7.50	
8	Theoretical (hour/week):	3.00	
9	Practice (hour/week):	0.00	
10	Laboratory (hour/week):	0	
11	Prerequisites:	END5115 SIMULATION ANALYSIS or any equivalent course	
12	Language:	Turkish	
13	Mode of Delivery:	Face to face	
14	Course Coordinator:	Prof. Dr. ERDAL EMEL	
15	Course Lecturers:		
16	Contact information of the Course Coordinator:	erdal@uludag.edu.tr Tel: 0224 294 2080 Endüstri Mühendisliği Bölümü, Mühendislik Fakültesi Bursa Uludağ Üniversitesi, Görükle, Bursa	
17	Website:	http://endustri.uludag.edu.tr	
18	Objective of the Course:	Determination of the optimal static and dynamic operating conditions for the stochastic production and service systems and establishment and analysis of their parametric and control simulation models	
19	Contribution of the Course to Professional Development:	Gives the ability to use reinforcement learning method using neural networks for optimal solution of problems such as maintenance planning, header pricing, stock management under stochastic demand.	
20	Learning Outcomes:		
		1	Gain the ability to create, verify, and validate simulation models
		2	Have an understanding the principles of simulation system implementation and have knowledge on advanced simulation methods
		3	Be able to develop new simulation methods and have knowledge on when to apply known methods
		4	Gain the ability to comprehend simulation analyses and interpret outputs from a simulation model
		5	Be able to simulate a complex model on a computer environment and have knowledge on up-to-date simulation software
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21	Course Content:		
	Course Content:		

Week	Theoretical	Practice
1	Simulation optimization: an overview Stochastic parametric optimization Stochastic control optimization	
2	Parametric Optimization: Response surfaces and neural nets RSM: an overview RSM: details Neuro-response surface methods	
3	Parametric optimization: Continuous optimization Discrete optimization (Ranking and Selection, Meta-Heuristics:Simulated Annealing, GeneticAlgorithm)	
4	Parametric Optimization: .- Stoch.Grad. and Adap. Search: Discrete Optimization (Stochastic Adaptive Search)	
5	Dynamic programming Stochastic processes Markov processes, Markov chains and semi-Markov processes Markov decision problems How to solve an MDP using exhaustive enumeration Dynamic programming for average reward	
6	Dynamic programming and discounted reward The Bellman equation: an intuitive perspective	
7	Control Opt.- Reinforcement learning: Curses	
8	7. Control Opt.-:Reinforcement learning: Semi-Markov decision problems and RL , Actor-critic algorithms	
9	Control Opt. - Reinforcement learning: Model	
10	Control Opt.- Reinforcement learning: Finite	
11	Control Opt.- Stochastic Search: MCAT Framework, Actor Critics	
12	Preventive maintenance. Production line buffer optimization	
13	RL Applications in MATLAB	
14	RL Applications in PYTHON	

Activites	Number	Duration (hour)	Total Work Load (hour)
Theoretical	14	3.00	42.00
Practicals/Labs	0	0.00	0.00
Self study and preperation	13	8.00	104.00
Homeworks	3	18.00	54.00
Projects	1	24.00	24.00
Field Studies	0	0.00	0.00
Midterm exams	1	2.00	2.00
Others	0	0.00	0.00
Final Exams	1	2.00	2.00
Total Work Load			228.00
Total work load/ 30 hr			7.60
ECTS Credit of the Course			7.50

22	Textbooks, References and/or Other Materials:	Simulation-Based Optimization, Abhijit Gosavi, Springer, 2015. Discrete Event System Simulation, 4th ed., J.Banks, J.S. Carson, B.L. Nelson, D.M. Nicol, Prentice Hall, 2005. Simulation Modeling and Analysis, 4th ed., Averill M. Law, McGraw-Hill, Inc., 2007. Simulation Using Promodel with CD-Rom, Charles R. Harrell, Biman K. Ghosh, Royce O. Bowden, McGraw-Hill, 2003. Approximate Dynamic Programming: Solving the Curses of Dimensionality, Warren B. Powell, Wiley-Interscience; 1st edition, 2007 Markov Decision Processes: Discrete Stochastic Dynamic Programming, Martin L. Puterman, Wiley-Interscience; 1st edition, 2005
23	Assesment	

TERM LEARNING ACTIVITIES	**NUMBER**	**WEIGHT**
Midterm Exam	1	20.00
Quiz	0	0.00
Home work-project	4	50.00
Final Exam	1	30.00
Total	6	100.00
Contribution of Term (Year) Learning Activities to Success Grade		70.00
Contribution of Final Exam to Success Grade		30.00
Total		100.00
Measurement and Evaluation Techniques Used in the Course		Measurement and evaluation are performed according to the Rules & Regulations of Bursa Uludağ University on Undergraduate Education.

24 ECTS / WORK LOAD TABLE

25 CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS

	PQ1	**PQ2**	**PQ3**	**PQ4**	**PQ5**	**PQ6**	**PQ7**	**PQ8**	**PQ9**	**PQ10**	**PQ11**	**PQ12**	**PQ13**	**PQ14**	**PQ15**	**PQ16**
ÖK1	0	0	3	0	0	5	0	0	0	0	0	0	0	0	0	0
ÖK2	0	0	0	0	0	0	5	3	4	0	0	0	0	0	0	0
ÖK3	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0
ÖK4	0	0	0	0	0	0	0	0	5	0	0	4	0	0	0	0
ÖK5	0	0	0	0	0	0	0	3	3	5	0	0	0	0	0	0

LO: Learning Objectives PQ: Program Qualifications

Contribution Level:	**1 very low**	**2 low**	**3 Medium**	**4 High**	**5 Very High**