Course Name: Stochastic Programming
Course Code: DS462

I. Basic Course Information

Major or minor element of program: Major
Department offering the course: Operations Research and Decision Support Department

Academic level: 400 Level
Semester in which course is offered: Second (spring) Semester
Course pre-requisite(s): DS361 Stochastic Models in Operations Research and Decision Support

Credit Hours: 3
Contact Hours Through:

Lecture	Tutorial *	Practical *	Total
2.5	1.5	0.0	4.0

* 1.5 hours for **either** Tutorial or Practical

Approval date of course specification: January 2015

II. Overall Aims of Course

The overall aim of this course is to enable the student to use stochastic programming in decision making under risk, for instance, decision analysis, dynamic programming and stochastic control. The student will be also able to use stochastic programming to tackle different problem classes and their characteristics, including linear and nonlinear programming theory and chance constrained programming that weighs heavily in stochastic programming. Finally, the course will be concluded with a discussion of Monte-Carlo based methods, stochastic decomposition and quasi-gradient methods.

III. Program ILOs covered by course

Program Intended Learning Outcomes (By Code)			
Knowledge & Understanding	Intellectual Skills	Professional Skills	General Skills
[K16,K17,K19]	[I11,I12]	[P12,P14]	[G4,G5,G6]

IV. Intended Learning Outcomes of Course (ILOs)

a. Knowledge and Understanding

On completing the course, students should be able to:

K.1 Explain the basic theory for the structure of stochastic programs and the foundation, terminology, and concepts associated from many disciplines including operations research, mathematics, probability, and decision making.

K.2 Recall the terms, basic capabilities, and limitations of stochastic programming models.

K.3 Recognize the algorithmic techniques and new computational tools used to solve stochastic programming models.

K.4 Define a broad overview of the main themes and methods of the stochastic models and the key results for optimality, decomposition, stochastic integer programming, and statistical inference.

K.5 Combine natural definitions of randomness of the problems with the existing features of the optimization systems, such extensions introduce powerful constructs for formulating complex stochastic programming and constrained programming models.

b. Intellectual/Cognitive Skills

On completing the course, students should be able to:

I.1 Formulate analytical models with quantified uncertainty as stochastic programs.

I.2 Develop state-of-the-art software and algorithms for stochastic programs.

c. Practical/Professional Skills

On completing the course, students should be able to:

P.1 Apply stochastic models to a variety of problems.

P.2 Develop and deliver problems status reports in a coherent manner.

P.3 Obtain deep and broad understanding of probability and its applications.

P.4 Use the appropriate software to implement modeling and analyzing of real problems.

d. General and Transferable Skills

On completing the course, students should be able to:

G.1 Improve written and oral communication skills, supported by the use of computers and group work.

G.2 Develop the interaction between theoretical, experimental and practical work.

G.3 Establish and ethic of efficiency as well as thoroughness.

V. Course Matrix Contents

	Main Topics / Chapters	Duration (Weeks)	Course ILOs Covered by Topic (By ILO Code)			
			K & U	I.S.	P.S.	G.S.
1-	Introduction about stochastic programming models	1	K1,K2			G3
2-	Linear programming with random parameters	1	K3			
3-	Recourse models' properties and algorithms	2	K4		P2	
4-	Stochastic mixed-integer programming	1	K1	I1	P3	

5-	Chance constraints	1	K1		P3	
6-	Multi-stage recourse models	1			P4	
7-	Monte Carlo sampling methods	1		I2		
8-	Stochastic dynamic systems	1	K1			
9-	Stochastic decision trees	2	K1		P2	
10-	Advanced stochastic programming models in network analysis.	2	K5	I1	P1	G1,G2
	Net Teaching Weeks	**13**				

VI. Course Weekly Detailed Topics / hours / ILOs

Week No.	Sub-Topics	Total Hours	Contact Hours	
			Theoretical Hours	Practical Hours *
1	Two stage problems	2.5	2.5	
2	Deterministic equivalent of a stochastic problem	4	2.5	1.5
3	Recourse models' properties and algorithms	4	2.5	1.5
4		4	2.5	1.5
5	Stochastic mixed-integer programming	4	2.5	1.5
6	Chance constraints	4	2.5	1.5
7	**Midterm Exam**			
8	Multi-stage recourse models	4	2.5	1.5
9	Monte Carlo sampling methods	4	2.5	1.5
10	Stochastic dynamic systems	4	2.5	1.5
11	Stochastic decision trees	4	2.5	1.5
12		4	2.5	1.5
13	Advanced stochastic programming models in network analysis.	4	2.5	1.5
14		4	2.5	1.5
15	**Final Exam**			
Total Teaching Hours		**51**	**33**	**18**

* **No Practical/Tutorial during the first week of the semester**

VII. Teaching and Learning Methods

Teaching/Learning Method	Selected Method	Course ILOs Covered by Method (By ILO Code)			
		K & U	Intellectual Skills	Professional Skills	General Skills
Lectures & Seminars	✓	All		P1,P3	G3
Tutorials	✓	K2,K3,K4,K5	I1	P1,P2	G1,G2
Computer lab Sessions	✓		I2	P2,P4	G3
Practical lab Work					
Reading Materials	✓	K1,K2,K3	I1	P3	G1
Web-site Searches	✓	K2		P4	G1
Research & Reporting					
Problem Solving / Problem-based Learning	✓			P3	
Projects					
Independent Work					
Group Work	✓	K3	I1	P2	G2
Case Studies	✓	K3,K4,K5	I1,I2		G3
Presentations					
Simulation Analysis					
Others (Specify):					

VIII. Assessment Methods, Schedule and Grade Distribution

Assessment Method	Selected Method	Course ILOs Covered by Method (By ILO Code)				Assessment Weight / Percentage	Week No.
		K & U	I.S.	P.S.	G.S.		
Midterm Exam	✓	All	I1	P1	G2	10%	7
Final Exam	✓	All	I1	P1	G2	60%	15
Quizzes	✓	K1	I2	P1	G1,G2	3%	3, 9
Course Work	✓	K3,K4,K5	All	P1,P2	G1,G3	10%	5, 10
Report Writing	✓			P2	G2	2%	11
Case Study Analysis	✓	K3		P1,P3,P4	G1	5%	13
Oral Presentations							
Practical							
Group Project	✓				G2	10%	12
Individual Project							
Others (Specify):							

IX. List of References

Essential Text Books	• Peter Kall and Stein W. Wallace, Stochastic Programming, John Wiley & Sons, 2003. • Peter Kall and Janos Mayer, Stochastic Linear Programming, Springer , 2005
Course notes	• None
Recommended books	• S.S. Rao, Optimization : Theory and applications, Wiley Eastern Limited, 1984
Periodicals, Web sites, etc …	• None

X. Facilities required for teaching and learning

- Appropriate teaching accommodation
- Computer lab
- Computer aided data show
- Laptop computer

Course coordinator: Ass. Prof. Tarek H. M. Abou-El Enien

Head of Department: Prof. Mohamed Mostafa Saleh

Date: January 2015