Course Type	Course Code	Name of the Course	L	T	P	Credits
DP	NMSC 504	Stochastic Programming Lab	0	0	3	1.5

Course Objective

Deterministic optimization problems assume that the value of problem parameters is known. In most practical situations, the problems invariably have some unknown parameters. Stochastic programming models assume that the probability distributions of such parameters can be estimated. The course objective is to learn to model such problems to determine decision variable value which is feasible for all (or almost all) the possible data instances and maximizes the expectation of some function of the decisions and random variables.

Learning Outcomes

On completion of this course, the students shall have learned the following:

1. The application of the General Algebraic Modeling System (**GAMS**) to model and solve mathematical programming problems in general and *few widely applied* stochastic programming problems
2. The concepts of these stochastic programming models and their industrial engineering applications
3. The convexity conditions for these models
4. The solution of these problems as their deterministic equivalent

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Modeling linear programming (LP) problem in GAMS	3	Using GAMS to model and solve LP and MIP problems.
2	Modeling mixed-integer linear programming (MIP) problem in GAMS	3	
3	Modeling Stochastic two-stage LP problem with recourse	3	Convexity conditions and Applications of these models in Industrial Engineering
4	Modeling Stochastic two-stage MIP problems with recourse	3	
5	Solving Stochastic two-stage *LP problem* with the uncertainty modeled using *Pseudo-random* numbers	3	1. Problem solution using Sample Average Approximation (SAA) Method. 2. Scenario generation method and its effect on in-sample stability and out-of-sample stability. 3. Implications of integer variable in Stage 1.
6	Solving Stochastic two-stage *LP problem* with the uncertainty modeled using *Quasi-random* numbers	3	
7	Solving Stochastic two-stage *MIP* problem with the uncertainty modeled using *Pseudo-random* numbers	3	
8	Solving Stochastic two-stage *MIP* problem with the uncertainty modeled using *Quasi-random numbers*	3	
9	**Improving solution quality using Variance-reduction techniques**	3	Applying Antithetic Variates method to improve solution stability.
10	Modeling Stochastic LP problem with a *chance constraint*	3	Convexity conditions and Applications of these models in Industrial Engineering
11	Solving Stochastic LP problem with *a chance constraint*	3	Problem solution using Robust/Scenario based optimization
12-13	Project Presentation	6	Apply the learning's to a problem in practice
14	Lab Exam	3	Evaluation
	Total Lecture Hours	**42**	

Text Books:

1. Haneveld, W. K. K., Van der Vlerk, M. H., & Romeijnders, W. (2019). *Stochastic programming: Modeling decision problems under uncertainty*. Springer Nature.

Reference Books:

1. Birge, J. R., & Louveaux, F. (2011). *Introduction to stochastic programming*. Springer Science & Business Media.