

A GIAN course on

Optimization of Uncertain Systems: Theory and Practice

Overview

Optimization is a very important tool that finds applications in all areas of engineering and science, and therefore, knowledge of optimization is critical from an academic as well as practical standpoint. However, future cannot be perfectly forecasted but instead should be considered random or uncertain. Consequently, the optimization problems need to consider these uncertainties, because ignoring those could potentially give sub-optimal solutions. Optimization under uncertainty refers to the branch of optimization where there are uncertainties involved in the data or the model, and is popularly known as Stochastic Programming or stochastic optimization.

The goal of this course is to discuss the theoretical foundations of stochastic programming. The course will provide a detailed understanding of various approaches to model and solve stochastic programming problems. The state-of-the-art solution methods (algorithms) will be explained and their advantages and limitations would be discussed. Dynamic systems are also subjected to uncertainties and hence the course will elaborate further on techniques to optimize dynamic systems using the approach of stochastic optimal control. In addition to providing theoretical understanding, the course will also give participants exposure to practical aspects of stochastic programming. This will be done through hands-on sessions as well as detailed discussion of case studies using stochastic optimization and optimal control.

Dates	December 19 – December 24, 2022 Number of participants for the course will be limited to fifty (60).
You Should Attend If...	<ul style="list-style-type: none"> ▪ You are an executive, engineer, or researcher from manufacturing sector ▪ You are a member of a policy thinktank or a non-governmental organization working on optimization strategies ▪ You are a part of the service and government organizations including R&D laboratories. ▪ You are a student at all levels (BTech/MSc/MTech/PhD) ▪ You are a faculty from academic institutions and technical institutions.
Fees	<p>The participation fees (including taxes) for taking the course for different categories is as follows:</p> <p>Industry: INR 28,320 Government research organization and NGOs: INR 10,620 Academic institutes (faculty members): INR 7,080 Students: INR 2,124 Participants from abroad: INR 84,960</p> <p>The above fee includes all instructional materials, 24 hr free internet facility, and lunch and tea during session breaks. The participants will be provided with accommodation on payment basis subject to availability.</p>

The Faculty



Prof. Urmila Diwekar is the founder and president of the Vishwamitra Research Institute, USA. She is also a faculty in the Department of Bioengineering, University Illinois, Chicago. Her research interests include stochastic optimization, environment and sustainability, molecular design, and health care applications.



Prof. Yogendra Shastri is a faculty in the Department of Chemical Engineering at the Indian Institute of Technology Bombay. His research interests are sustainability assessment, biomass to energy systems, municipal solid waste management, and optimization.

Course Co-ordinator

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Detailed Course Outline

Day	9:30 to 11:00	11:30 to 13:00	14:00 to 15:30	16:00 to 17:30
1	Deterministic optimization, theory of constrained optimization, and solution methods (UD)	Deterministic optimization: Decomposition methods (UD)	Tutorial: Application of GAMS for solving simple optimization problems (YS)	Presence of uncertainty in optimization problems (UD)
2	Introduction to stochastic optimization (UD)	Importance of sampling in stochastic optimization (UD)	Tutorial: Application of GAMS for solving a simple stochastic optimization problem (YS)	Case study of stochastic optimization (YS)
3.	Stochastic optimization solution methods (UD)	Stochastic optimization solution methods (UD)	Tutorial: L-shaped method and Stochastic Decomposition approach with GAMS software (YS)	Case study of stochastic optimization (YS)
4	Applications of Stochastic Optimization: Batch distillation and waste water treatment (UD)	Deterministic optimal control and stochastic dynamics processes (Ito processes) (UD)	Tutorial: Application of MATLAB/Scilab/Python to model stochastic processes (YS)	Case study on stochastic processes: Human mortality, batch distillation (UD)
5.	Stochastic optimal control (UD)	Case study of stochastic optimal control (YS)	Case study of stochastic optimal control (UD)	Course summary, discussion, and doubt clarification session (UD, YS)
6.	Examination (UD, YS)		Course-wrap up and feedback session (UD, YS)	

Lectures will be accompanied by active learning interactive sessions to promote learning. Interactive sessions will involve group problem solving, group discussion, and working on open source or demonstration versions of software packages.

Course Faculty:

UD Urmila Diwekar

YS Yogendra Shastri