



**One Week Online Course
on**

**STOCHASTICS PROCESSES: THEORY AND ITS APPLICATIONS
IN MEDICAL SCIENCES
14-18 March, 2022**

**Sponsored by Ministry of Human Resource Development (MHRD)
under the scheme of Global Initiative of Academic Networks (GIAN)**



Organised by
**DEPARTMENT OF MATHEMATICS
MAHARSHI DAYANAND UNIVERSITY
ROHTAK-124001(HARYANA), INDIA**

MHRD Scheme on Global Initiative on Academic Network (GIAN)

STOCHASTIC PROCESSES: THEORY AND ITS APPLICATIONS IN MEDICAL SCIENCES

14-18 March 2022

1. Overview

A nation's growth and success can be determined by the health and lives of its natives as they are their living assets. Every nation wishes to improve the quality of their people's health and lives, consequently, scientists throughout the world expanding their knowledge base in different fields to eradicate the problems that cause people's illness and death. Owing to this, applications of the concepts of stochastic processes to the study of human disease progressions and controlling disease related morbidity and mortality have been widely attempted.

The notion of stochastic processes is very important both in mathematical theory and its applications in science, engineering, economics, etc. It is used to model a large number of various phenomena where the quantity of interest varies discretely or continuously through time in a non-predictable fashion. In fact, stochastic analysis, a basic tool to handle and study the variability and uncertainty in a phenomenon, provides a fertile ground to use the concepts of stochastic processes to the probabilistic phenomenon encountered in various fields.

Mathematical models have been found to play an important role in the study of various systems as the models apart from analysis with varied parameters make possible to predict about the behavior of the systems. The real benefits have been gained in using stochastic rather than deterministic models, particularly when modeling biological phenomena. In fact, stochastic modeling is the development of mathematical models for probabilistic systems which can adopt many possible behaviors starting from any given initial condition.

In a biological phenomenon or system, a specific assignment is performed by an organ system which is the group of anatomical structures that work together and the failure of even one organ system could lead to severe disability or even death. These systems involve several uncertainty factors, stochastic modeling plays an important role especially in investigating the biological systems having some diseases as the models help in understanding the mechanism of diseases in terms of explaining relationships between development and progression in disease stages and other relevant covariates.

Further, various human or diagnostic machines related errors causing injury or death among the patients are also a very significant matter of investigation. It has been established that various processes or machines/equipment employed for the hospitalizations/ medical treatments of the patients play a vital role in diagnosis/recovery of the diseases/ organs and hence the patients. Moreover, the systems being used for the purpose are the most expensive and high technological diagnostic/ treatment tools. Using the concepts of stochastic processes, a large number of manufacturers, engineers, medical scientists and researchers have also investigated these aspects. Moreover, the deep learning and machine learning methods are getting popular in medical science in these days.

2. Objectives

The primary objectives of the course are as follows:

- i. Exposing the participants about the fundamentals of stochastic processes with theoretical knowledge.
- ii. To give knowledge about the developments and analyses of stochastic models taking problems from medical science, engineering and other fields.
- iii. Provide exposures to the participants about various applications of stochastic analyses.
- iv. To aware the participants about varied problems related to human diseases, their risk factors and treatments; human organ systems and human physiology.
- v. Training the participants in fundamentals of deep learning and machine learning models and case studies in medicine.
- vi. Building confidence and capability amongst the participants to identify problems in various fields especially in the areas of medical sciences and to obtain their remedial solutions through the stochastic analysis.

3. Teaching Faculty with Allotment of Lectures and Tutorials

1. Prof. Arni S.R. Srinivasa Rao (ASR) : 8 hrs lectures and 4 hrs tutorials
2. Prof. Rajeev Kumar (RK) : 2 hrs Lectures
3. Dr. Poonam Redhu (PR) : 2 hrs Lectures

4. Course Details

The main topics that will be covered are as follows:

1. Stochastic processes
2. Mathematical modeling of real life problems
3. Stochastic models for human organ systems and diseases
4. Deep learning in medicine
5. Public health and epidemic data modeling
6. Stochastic analyses of various hospital systems

4.1 Duration

March 14 –18, 2022 (5 days): 12 hrs lectures and 04 hrs Tutorials

4.2 Schedule

Day-1 (14 March, 2022)

Lecture 1: 1 hrs: 5:00 PM – 6:00 PM: RK

Stochastic modeling of some real life problems

Lecture 2: 1 hrs: 6:15 PM – 7:15 PM: ASR

Concepts of stochastic processes and their examples

Lecture 3: 1 hrs 7:30 PM – 8:30 PM: ASR

Deep learning in medicine: Introduction and applications

Day-2 (15 March, 2022)

Lecture 4: 1 hrs: 5:00 PM – 6:00 PM: PR

Mathematical modeling and its applications to diversified fields

Lecture 5: 1 hrs: 6:15 PM – 7:15 PM: ASR

Applications of stochastic processes in the study of diseases, their risk factors and treatments

Tutorial 1: 2 hrs: 7:30 PM - 9:30 PM: ASR

Classification of stochastic process, Markov chain, solving the Kolmogorov equations in simple cases

Day-3 (16 March, 2022)

Lecture 6: 1 hrs: 5:00 PM – 6:00 PM: RK

Analysis of some stochastic models for human organ and hospital systems

Lecture 7: 1 hrs: 6:15 PM – 7:15 PM: ASR

Antiretroviral therapy and HIV/AIDS treatment in India, modeling cost and consequences of policy options

Lecture 8: 1 hrs: 7:30 PM - 8:30 PM: ASR

Stochastic models for chronic diseases and their analyses

Day-4 (17 March, 2022)

Lecture 9: 1 hrs: 5:00PM – 6:00PM: PR

Statistical mechanisms of motor protein transport

Lecture 10: 1 hrs: 6:15 PM – 7:15 PM: ASR

Dynamic risk prediction or cardiovascular diseases, and statistical models for the diseases

Lecture 11: 1 hrs: 7:30 PM - 8:30 PM: ASR

Epidemic data modeling

Day-5 (18 March, 2022)

Lecture 12: 1 hrs: 5:00PM – 6:00PM: ASR

Public health issues and their analyses

Tutorial 2: 2 hrs: 6:15 PM – 8:15 PM: ASR

Models in biostatistics and their applications

Date of Examination: 18 March, 2022

5. Who can attend?

- Doctors, Executives, Engineers and Researchers from industries, hospitals, services and government organizations including R&D laboratories.
- Student at all levels (B.Tech./ M.Sc./ M.Tech./ Ph.D./ MBBS) or Faculty from reputed academic institutions including medical and technical institutions.

6. Fee Structure

The fees for attending the Course (other than one time GIAN Course Registration fees Rs. 500/- (Non-refundable)).

Students/ Research Scholars	Rs. 250/- (UR/OBC); Rs. 150/- (SC/ST)
Faculty	Rs. 500/-
Industry Participants	Rs. 1000/-
Participants from Countries other than INDIA	USD 50

The participation fee includes instructional lecture materials and virtual laboratory use for tutorials and assignments. The link of the programme will be shared to the participant for online lectures of the speakers.

7. Maximum Number of Seats

Number of participants for the course will be limited to fifty (50).

How to Apply

Registration Process: Registration for GIAN courses is not automatic because of the constraints on maximum number of participants allowed to register for a course. In order to register for one or multiple non-overlapping courses, you have to apply online using the following steps:

1. Create login and password at <http://www.gian.iitkgp.ac.in/GREGN/index>
2. Login and complete the registration form.
3. Select courses.
4. Confirm your application and payment information.
5. Pay Rs. 500/- (non-refundable) through online payment gateway.
6. The course coordinators of the selected course will go through the submitted application and will confirm the selection as a participant. After shortlisting and selection, the participant(s) have to pay the required registration fees within a stipulated time. The Bank and other details for the payment and course registration will be send to the shortlisted participants through e-mail.

Foreign Faculty



Prof. Arni S.R. Srinivasa Rao is a Professor in the Medical College of Georgia and Director at the Laboratory for Theory and Mathematical Modeling, Medical College of Georgia, Augusta University. Prof. Rao held a permanent faculty position at Indian Statistical Institute, Kolkata until 2012. He had taught and performed research at several premier institutions including, the Indian Statistical Institute (ISI), University of Oxford (Oxford, UK), the Indian Institute of Science (Bengaluru, India) and University of Guelph, (Guelph, Canada) prior to his joining at Augusta University, Augusta, Georgia, United States. He has more than 60 research publications to his credit. Dr. Rao has proved a fundamental theorem in stationary populations (Rao-Carey Theorem), Partition Theorem in populations. Artificial Intelligence Models for COVID-19 and HIV/AIDS models developed by him were used in policy formulations. He is currently series co-editor of *Handbook of Statistics* (Elsevier), COVID-19 special issue guest editor of *Journal of Mathematical Analysis and Applications* (Elsevier), special issue guest editor of *Journal of Indian Institute of Science* to be released in 2022, the member of editorial boards in many reputed journals such as “*Demography India*”, “*Journal of the Indian Society for Probability and Statistics*” and “*Theoretical Biology and Medical Modeling*” etc.

Course Coordinator



Prof. Rajeev Kumar is working as a Professor and Head of Department of Mathematics at Maharshi Dayanand University, Rohtak. He is awarded by ISITA Award-2018 for Excellence in Academics and Research. He has served as Director, Department of Alumni Relations, Maharshi Dayanand University, Rohtak. Presently, he is the member of various National/ International academic/ research societies and editorial boards of several research journals. He has authored more than 70 research papers in reputed International/ National journals. He presented research papers, delivered expert talks as Keynote/ Plenary speaker and chaired Technical Sessions at about 80 National and International Conferences in INDIA and ABROAD. He has

been a member of Advisory Boards/ Convener/ Organising Secretary/ Coordinator for number of Conferences/ Seminars/ Workshops of National/ International levels organised by various Universities/Colleges/Institutes. He is having more than 30 years of teaching/ research experience and guided number of Ph.D. and M.Phil. Dissertations in the area of Stochastic Modelling and Analyses, Information Theory, Bio-Mathematics, Operations Research and Statistical Estimation.

Course Deputy Coordinator



Dr. Poonam Redhu is presently working as Assistant Professor in the Department of Mathematics at Maharshi Dayanand University Rohtak. She obtained her Doctorate Degree from Indian Institute of Technology (IIT) Ropar, Punjab. She has published a couple of research papers in reputed journal and currently is working on Mathematical Modeling and Traffic Flow. She also presented papers in International and National conferences in India and Abroad. Dr. Redhu also awarded by financial support from ICIAM-2015, Beijing, China. She delivered the extension lecture in the webinar. She acted as a referee for many journals including *Physica A*, *Physics Letter A* and *Nonlinear Dynamics* etc.

Contact Details

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