

## ***Principles of Drug Discovery, Design, and Development:***

### ***Modern Concepts and Applications***

*Under the aegis of MHRD—Global Initiative of Academic Networks*

URL: <http://iiti.ac.in/GIAN/>

#### **Overview**

Medicinal chemistry is a highly interdisciplinary science, involving various aspects of chemistry, biochemistry, physiology, microbiology, cell biology, pharmacology, and computational studies. From a broad perspective, the practice of medicinal chemistry encompasses the invention / discovery, identification, design, and preparation of bioactive compounds, elucidation of their mode of action at molecular level, understanding of the structure-activity relationships (SAR), and the optimization of the pharmacokinetic (PK) and pharmacodynamic (PD) properties essential for their eventual therapeutic application. Medicinal chemistry is thus central to modern drug discovery endeavors.

The practitioners of medicinal chemistry play vital roles in academia, and in pharmaceutical industry. In a norm, rather than exception, fundamental research driven medicinal chemical discoveries from academic laboratories regularly translates into pharmaceutical industry driven development of new and novel therapeutic agents. In an encouraging trend, in recent years, it has become increasingly common for pharmaceutical companies to set-up collaborations with academia in search of new drugs and drug targets.

Surprisingly, compared to the relatively large number of academic and research institutes offering foundational education/training opportunities (undergraduate/graduate) in fundamental scientific disciplines such as Chemistry, Biochemistry, and Biology etc., there are very few institutions imparting specialized coursework and training in Medicinal Chemistry (this is even more true in India). In an indisputable fact, the sustenance and advancement of medicinal chemical discoveries are critically dependent on the availability of researchers well-versed on the modern aspects of medicinal chemistry. It is therefore of vital importance to attract younger generations of students to this continuously evolving discipline, and provide them the knowledgebase, research training, and adequate facilities to be successful medicinal chemical researchers of tomorrow.

Accordingly, this course, aimed at undergraduates/graduates with basic grounding in organic chemistry, is designed to provide the participants a broad overview of medicinal chemistry, with a special emphasis on the theoretical and practical aspects of modern drug design concepts, discovery, and development. Appropriate examples of organic medicinal agents (drugs), including consideration of their origins, chemical properties, pharmacological activities, mechanisms of action, and structure-activity relationships (SAR) etc. will be discussed. Representative ‘case studies’ will also be included.

#### **Schedule of the Course**

<b>Schedule of the course</b>	: May 27-June 07, 2019
<b>Total Number of days/lectures</b>	: 10-days/20-lectures and 10 tutorials

#### **Registration Fee**

<b>Participant from outside India</b>	: USD 500
<b>Industry/ Business organization</b>	: Rs. 10,000
<b>Academic Institutions</b>	: Rs. 2,000
<b>Students/College teachers</b>	: Free for first 25 participants or Rs.1500/-

The fee includes all instructional materials, computer use for tutorials, and internet facility. The participants will be provided with accommodation at IIT Indore hostel on payment basis.

## Topics Covered

Medicinal Chemistry: Introductory aspects, general background, objectives, common terminologies, and various stages in drug discovery/development; Drug targets, target identification, mechanism of action, biological activity evaluation, and drug classification; Drug-like properties, concepts, and current practices; Enzyme inhibitors; Drug chirality and pharmacological consequences; Thalidomide story and the lessons learnt; Tools of the trade: Combinatorial synthesis (combi-chem) and applications in drug discovery; 'Hits' in drug discovery, and 'Hit-to-Lead' (H<sub>2</sub>L) modification approaches; Natural products and endogenous ligands as drugs / hits; Medicinal chemistry of natural products (a representative case study); Analog-based drug design, strategies, approaches, and examples; Pen G-Pen V-Methicillin-Ampicillin: An 'evolutionary' story; Rational drug design: From pit viper venom to anti-hypertensives; Structure-based drug design: Concepts, strategies, and practices-Case study; Fragment-based drug design: Concepts, strategies, and practices-Case study; Prodrugs and soft drugs: Concepts, strategies, and examples; Hybrid drugs and chimeric drugs: Concepts, strategies, and examples; Hybrid drugs vs combination therapy: Pros and cons

## Faculty Information



### Teaching Faculty

**The course will be delivered by Professor Apurba Dutta, Associate Professor of Medicinal Chemistry, at The University of Kansas, Lawrence, USA.** After receiving his PhD (1989) in chemistry from the North-Eastern Hill University, Shillong, India, he carried out postdoctoral research in the University of Konstanz, Germany (Alexander von Humboldt Fellowship; 1991-92), and in the University of Kansas, Lawrence, USA (1993-95). In April 1995, he started his independent research career, and accepted a research scientist position ('Scientist C') at the Indian Institute of Chemical Technology, Hyderabad, India. In 1999, he returned to a teaching and research career at the University of Kansas, initially as an Assistant Director of the Drug Discovery Program at the Higuchi Biosciences Center, while also holding an Assistant Research Professor position in the Department of Medicinal Chemistry (1999-2001). Subsequently, he joined the Medicinal Chemistry Department as a tenure-track Assistant Professor (2001), followed by subsequent tenure and promotion to Associate Professor (2007).

Dr. Dutta is actively involved in basic research in Medicinal Chemistry and Organic Chemistry. Research in his group is directed at the synthetic and medicinal chemical investigations of natural, and nature-like compounds of biological significance. A major focus of his research is aimed at the discovery and

development of new and novel classes of anti-infective agents, targeting anti-fungal (chitin synthase inhibition), antibacterial (endotoxin sequestration, immune adjuvant), and anti-viral (HIV-protease inhibition) therapeutic areas. A second research area, involving new and novel anti-cancer targets include proteasome inhibition, and modulation of sphingolipid metabolism. Pursuing the above studies, the various compound classes being investigated in his research include, nucleosides, alkaloids, nitrogen-containing heterocycles, amino acids, peptides, peptidomimetics, carbohydrates, carbohydrate mimics, lipopolyamines, and sphingolipids.

In various research projects, Dr. Dutta is also involved in active collaboration with departmental and extra-departmental colleagues within the University, and with academic and pharmaceutical industrial researchers across the country. In his research career until now, Dr. Dutta has published more than 75 peer-reviewed research articles, reviews, and book chapters, and is also a co-inventor in 3 US patents.

In addition to his research activities, Dr. Dutta is also involved in regular teaching of basic and advanced medicinal chemistry courses to the pharmacy students (Pharm.D program; average class sizes 150–170) in the School of Pharmacy, and graduate students (MS and Ph.D. programs; average class sizes: 8–12) in the department of Medicinal Chemistry. In recognition of his teaching activities, he has been a recipient of the ‘Teaching Excellence’ award from the University of Kansas Center for Teaching Excellence (KU–CTE). He is also a regular participant as a committee member and examiner, for comprehensive oral examinations and thesis defense of graduate students in the departments of Medicinal Chemistry, and Chemistry in the University of Kansas, as well as external examiner of Ph.D. theses from various countries in Asia (including Indian universities and research institutes).



### Coordinating Faculty

**Dr. Venkatesh Chelvam**, an Organic Chemist and Chemical Biologist is an assistant professor in the Discipline of Chemistry and Biosciences and Biomedical Engineering at IIT Indore. His long-term goal is to establish a centre of excellence in the field of bio-science especially for detection and treatment of cancer and inflammatory diseases at IIT Indore. He has more than 10 years of experience in imaging and microscopic techniques for diagnosis and therapy of diseased condition from Purdue University, USA. He was also a postdoctoral fellow in the laboratory of Prof. Hans-Ulrich Reissig at Freie University Berlin, Germany in 2006-2008, where he was awarded Alexander von Humboldt fellowship and worked on total synthesis of natural products for cancer. He has published more than 34 peer reviewed journal papers in highly reputed international journals and some of his outstanding discoveries were published in prominent journals such as *Current Protocols in Chemical Biology*, *Nanomedicine*, *Journal of Nuclear Medicine*, *Journal of Cell Sciences*, *Journal of Medicinal Chemistry*, *Molecular Pharmaceutics*, *Bioconjugate Chemistry*, *Journal of Organic Chemistry*, *European J. Organic Chemistry*, *Organic Letters*, etc. His revolutionary work on diagnosis and therapeutic applications of cancer and inflammatory diseases are US patented, and currently in clinical trials. Moreover, he had appeared in ABC news for developing technology for intra-operative guided surgery of ovarian cancer in patients.

### Who should attend this course?

1. Chemists from Pharmaceutical Industry
2. Researchers from Industry and government organizations including R&D laboratories.
3. Students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions.

### Course Coordinator

**For any further information and registration, please contact:**

**Dr. Venkatesh Chelvam**

*Assistant Professor*

Discipline of Chemistry

Discipline of Biosciences and Biomedical Engineering

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**Relevant Readings for the proposed course:**

- ✓ An Introduction to Medicinal Chemistry (G. L. Patrick; 5th Edn.)
- ✓ The Organic Chemistry of Drug Design and Drug Action (Silverman and Holladay; 3rd Edn.)
- ✓ The Practice of Medicinal Chemistry (Wermuth, Aldous, Raboisson, and Rognan (Eds); 4th Edn.)
- ✓ Textbook of Drug Design and Discovery [Krogsgaard-Larsen, Strømgaard, and Madsen (Eds); 4th Edn.]
- ✓ Drug-like Properties: Concepts, Structure Design and Methods (Kerns and Di)
- ✓ Burger's Medicinal Chemistry, Drug Discovery, and Development (8th Edn.): Vol. 1; p 127-166.
- ✓ Chirality in Drug Research [Francotte and Lindner (Eds); Vol. 33; Wiley-VCH, 2006]
- ✓ Analogue-based Drug Discovery [Fischer and Ganellin (Eds); Wiley-VCH, 2006]
- ✓ Structure-based Drug Discovery: An Overview [R. E. Hubbard (Ed); RSC, 2006]
- ✓ Fragment-based Approaches in Drug Discovery [Jahnke and Erlanson (Eds); Vol. 34]