

Chemical Biology: The Integration of Chemistry, Biology and Medicine

Under the aegis of MHRD—Global Initiative of Academic Networks

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

Overview

This multidisciplinary course will discuss how intractable problems in biology can be solved through the application of synthetic organic chemistry and how biology can be harnessed to advance chemistry. The central dogma of molecular biology is the organizing principle for this course. Starting from DNA, RNA, proteins and their post-translational modifications we will initially focus on the origin, chemistry, structure and functions of these fundamental building blocks of life in cells. We will then proceed for an in-depth review of highly innovative chemical approaches that are used to harness these macromolecules to regulate and monitor numerous biological processes in real time. In addition, we will also discuss several innovative approaches to manipulate biological systems to facilitate novel chemical syntheses. Recent discoveries and their applications, particularly in human diseases, from both literature and industry will be a cornerstone of the course.

This course has no prerequisite. A synthetic organic chemist with no background in biochemistry or a biologist/biochemist with no chemistry knowledge are equally eligible.

The primary objectives of the course are as follows:

- ❖ Introduce organic chemists to biological systems. A review of the structure and functions of basic biological macromolecules will be provided. The key players and the mechanism by which they are synthesized in cells such as DNA Replication, Transcription and Translation will be discussed. This will set the stage for subsequent applications of chemical tools to unravel various biological phenomena.
- ❖ Several innovative tools will be discussed in details where the power of chemistry is harnessed to probe biological systems at molecular, cellular, and organismic levels.

Schedule of the Course

Schedule of the course	: Dec 12–Dec 23, 2016
Total Number of days/lectures	: 10 days / 20 lectures and 10 tutorials

Registration Fee

Participant from outside India	:USD 500
Industry/ Business organization	:Rs. 20,000
Academic Institutions	:Rs. 2,000
Students	:Rs. 2,000

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

Topics Covered

Introduction to Chemical Biology, Structure of cell, Macromolecules and monomeric units; DNA in cells: DNA Structure, G Quadruplex DNA and Replication; DNA mutagenesis, DNA microarrays, combinatorial synthesis; DNA Encoded Chemical Libraries (DECL) and DNA Templated Organic Synthesis (DTS); DNA Assisted Reaction Discovery, Adapting DECL for DNA Microarrays synthesis; G Quadruplex ligands and Inhibitors, High ordered DNA packaging. Application in Cancer; DNA Aptamers, SELEX, Real time Imaging and Targeting in Cancer, FRET Probes for DNA and applications; Aptamer-tethered DNA nanotrains, Selective delivery of an anticancer drug with aptamer- functionalized liposomes; RNA world, Transcription; Wrinkle in the central dogma, Types of non-coding RNAs, RNA interference, Transposons; Transcription Profiling, RNA Aptamers, RNA as therapeutics; Rapid Selex, Riboswitches and Ribozymes; Proteins in Cells: Structure and Functions, Translation; Solid Phase Peptide Synthesis, Chemical Ligation, Inteins; Unnatural amino acids and their translation in cells- Function as probes; Selective labeling of proteins using orthogonal probes, Chemical Probes/Disruptors of Protein-Protein Interactions; Forward and Reverse Chemical Genetics, High-throughput Screening, Reporter Assays; Small molecule target identification using affinity labeling; Fragment based drug discovery, DARTS; PROTACS, Bump-hole approach.

Faculty Information



Teaching Faculty

The course will be delivered by Professor Dr. Kavita Shah, Purdue University, USA

Dr. Kavita Shah is a Professor in the Department of Chemistry, Purdue University, USA and her background is deeply ingrained in chemical biology, signal transduction and drug discovery, with specific expertise in kinase signaling in Cancer and Alzheimer's disease (AD). She was instrumental in the development of the chemical genetic approach for the identification of direct substrates of kinases on a proteome-wide scale and published numerous papers in top-notch journals using this approach.

As a Group Leader at Genomics Institute of Novartis Research Foundation, she led a team of several postdoctoral associates involved in target identification, validation, ultra-high through-put screening (using 2 million compounds library) and drug development in Oncology, which led to the discovery of highly potent and selective kinase inhibitors for cancer. At Purdue, her research group is deeply interested in unraveling the molecular mechanisms of neuro-degeneration in AD models, with the goal of identifying novel therapeutic targets that can be targeted independently or in combination to prevent or delay neuro-degeneration. In her laboratory she has extended this approach to many oncogenic kinases as well, which has led to the identification of highly cancer-specific targets in castration-resistant prostate cancer and highly lethal pancreatic cancer. She has successfully collaborated with researchers in the US and abroad, and published several peer-reviewed articles with them. To summarize, she has an established record of successful and productive research in the areas of target identification,

validation and cell signaling in cancer and neuro-degeneration.



Co-ordinating Faculty

Dr. Chelvam Venkatesh, an Organic Chemist and Chemical Biologist is an assistant professor in the Discipline of Chemistry and Centre for 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 7 years experience in imaging and microscopic techniques from postdoctoral training at the 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 24 peer reviewed journal papers in highly reputed international journals and some of his outstanding discoveries were published in prominent journals such as *Nanomedicine*, *Journal of Nuclear Medicine*, *Journal of Cell Sciences*, *Journal of Medicinal Chemistry*, *Journal of 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.



Dr. Prashant Kodgire, a molecular biologist, is an assistant professor in the Discipline of Biosciences and Biomedical engineering at IIT Indore. Dr. Kodgire received the prestigious Ramanujan fellowship from the Department of Science and Technology, Govt. of India, which is meant for brilliant scientists from all over the world to take up scientific research positions in India, especially those scientists who want to return to India from abroad. Prior to joining IIT Indore, Dr. Kodgire received his postdoctoral training at the Department of Molecular Genetics and Cell Biology, University of Chicago, Chicago, USA. During his postdoctoral training at the University of Chicago, he received the international postdoctoral fellowship award from the Lady Tata Memorial Trust, UK that is awarded for cutting-edge research in leukaemia and related areas, in 2008. Subsequently in 2009, he received another very prestigious Irvington Institute's postdoctoral fellowship from the Cancer Research Institute, USA, which is awarded to only 16 fellows in the United States every year, to work in immunology and cancer immunology. Dr. Kodgire received his doctoral degree from Indian Institute of Technology Bombay, Mumbai. His doctoral research work is broadly in the area of transcriptional regulation of motility associated genes in *Bacillus subtilis*. Dr. Kodgire has 23 peer reviewed publications, including 9 journal papers. Part of his research work carried out at the University of Chicago is published in highly reputed journals, such as *Journal of Experimental Medicine* and *Molecular and Cellular Biology*. His very recent work carried out at IIT Indore, in collaboration with the University of Chicago, is published in the *Journal*

Who should attend this course?

1. Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories.
2. Undergraduates, M.Sc, and PhD science stream students. Any student with a basic chemistry background will be able to follow these lectures and gain a lot from them.
3. B.Sc and M.Sc level teachers who wish to update their knowledge in frontiers of biology.

Course Co-ordinators

For any further information and registration, please contact:

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