

# Chemistry and Biology of Carbohydrates

Under the aegis of MHRD—Global Initiative of Academic Networks

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

## Overview

This multidisciplinary course will introduce the glycosciences as an emerging discipline of high importance in medicine, biotechnology, and material science. In biological systems carbohydrates are important for cell-cell interactions, signal transduction, and as determinants for the immune system. As the major component of plant biomass, carbohydrates have emerged as a promising renewable resource that may displace a significant fraction of petroleum-derived products such as biofuels or functional materials. The participants will learn about the occurrence, biosynthesis, and function of carbohydrates in animals, bacteria, and plants. Chemical synthesis plays a key role in understanding the biological function of carbohydrates. Basic synthetic strategies towards the synthesis of complex glycans including chemo-enzymatic methods as well as novel technologies such as automated glycan assembly are discussed. Synthetic glycans find wide applications, e.g. as novel vaccine candidates and carbohydrate-based therapeutics. The impact of glycoscience on medicine and the importance of biomass-based glycans as a source for materials and fuels are key topics of this course.

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

The primary objectives of the course are as follows:

- ❖ After completing the course, the participants will be able to design chemical syntheses of complex glycans with potential applications in biology.
- ❖ The participants will learn about the biosynthesis of glycans and how to use enzymes for the preparation and modification of glycans.
- ❖ The participants will be introduced to the manifold applications of synthetic as well as natural glycans in medicine, biotechnology, and material science.

## Schedule of the Course

<b>Schedule of the course</b>	: Nov 06–17, 2017
<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. 20,000
<b>Academic Institutions</b>	: Rs. 2,000
<b>Students</b>	: 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

Occurrence of carbohydrates in mammals, bacteria, and plants, nomenclature, Glycopolymers and glycoconjugates, Chemical synthesis of glycans: General considerations, synthetic strategies, Synthesis of rare carbohydrates, carbohydrates as building blocks in the total synthesis of natural products, Glycosyl donors / leaving groups, Protecting groups for carbohydrates, Reactivity and selectivity of glycosyl donors, novel developments in glycosylation reactions, Automated glycan assembly (AGA), Chemo-enzymatic synthesis of glycans, Analysis of synthetic glycans, Biosynthesis of carbohydrates: Nucleotide sugars, Oligosaccharides and glycoconjugates, Carbohydrate-protein interactions: Antibodies, lectins, blood group determinants, Biophysical methods to evaluate carbohydrate-protein interactions, Carbohydrate-based therapeutics: inhibition of carbohydrate-lectin interactions, targeting of drugs via carbohydrate-lectin interactions, Antibiotics, glycosidase inhibitors, Metabolic glycan engineering, biorthogonal labeling, Carbohydrate-based vaccines, Plant glycans and biomass, Utilization of biomass for the production of fuels and materials.

## Faculty Information



### Teaching Faculty

**The course will be delivered by Dr. Fabian Frenge, Max-Planck-Institute of Colloids and Interfaces, Germany**

Dr. Fabian Frenge is a scientist and a group leader at the Max-Planck-Institute of Colloids and Interfaces, Germany (Director: Prof. Peter H. Seeberger). His research deals with the chemical and enzymatic synthesis of plant carbohydrates and their application in plant biology, immunology, and material sciences. He produced the world-wide largest available library of synthetic plant carbohydrates using the novel technology of automated glycan assembly. In an interdisciplinary lab he is applying his compounds in a multitude of biological experiments. Despite the early stage of his career, these results were already published in a number of top-notch journals.

Before his independent career, Dr. Frenge received an education in synthetic organic chemistry as a PhD-student in the lab of Prof. H.-U Reißig and subsequently performed a postdoctoral stint in the lab of Prof. James Paulson at the Scripps Research Institute (TSRI) in La Jolla, USA. Prof. Paulson is one of the leading researchers in the field of glycobiology and served as the president of TSRI. During that time Dr. Frenge was engaged in the chemo-enzymatic synthesis of high-affinity glycan ligands. He used nanoparticles decorated with these ligands to suppress unwanted immune responses in vivo. His work was published in numerous publications in journals such as *Angewandte Chemie* and *Journal of Clinical Investigation*.



### Host 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.

### 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-ordinator

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

**Dr. Chelvam Venkatesh**

*Assistant Professor*

Discipline of Chemistry

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