

# Molecules to Humans: Applications of Multidimensional NMR in Deciphering Biomolecular Structures, Functions and Cellular Mechanisms.

## Overview

Advanced NMR (nuclear magnetic resonance) spectroscopy methods have been used to solve the three dimensional structures of biomolecules such as proteins, enzymes, nucleic acids and lipid membranes. Additionally, this technique can quantitatively monitor the thermodynamic and kinetic aspects of interactions of proteins and ligands (e.g., drug molecules). In fact, it can even be used to track *in vivo* metabolism in humans and animals as well. With the introduction of two-dimensional (2D) NMR experiments and subsequent development of 3D/4D NMR technologies, atomic level interpretation of macromolecular interactions has become possible. This course will cover all major aspects (Principles/Instrumentations/Applications) of multi-dimensional NMR methods such as [<sup>1</sup>H, <sup>13</sup>C, <sup>15</sup>N] resonance COSY, NOESY, SECSY, TOCSY and TROSY with applications in deciphering biomolecular structures and mechanisms, and cellular metabolism and functions. Applications of NMR in cancer metabolomics and drug metabolism will also be covered in this course. Further, applications of NMR in regulation of gene expression will be presented in this course toward molecular understanding of the most essential biological process and therapeutic development, since gene expression is central to all cellular processes and functions, and misregulation of gene expression is associated with a growing number of human diseases including various types of cancers.

Through this coursework and lecture series, we would like to share the recent strategic improvements and striking results obtained using this technique with the students, researchers and faculty. This interdisciplinary topic will find audience among the fields of chemical sciences, material sciences, medicine, biological sciences & engineering, etc.

<b>Modules</b>	<b>Following topics will be covered from December 2-7, 2019.</b> <b>A:</b> Eukaryotic gene regulatory mechanisms and disease pathogenesis; <b>B:</b> Genome integrity and cancer; <b>C:</b> Metabolism and diseases; <b>D:</b> NMR and its application to study above processes and associated diseases; <b>E:</b> NMR in therapeutic development; and <b>F:</b> Hands-on-experience in analyzing NMR data <b>Number of participants for the course will be limited to 40.</b>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"><li>▪ You are a Researcher from Industry and government organization including R&amp;D laboratory.</li><li>▪ You are a Student (B. Tech., M. Tech., M. Sc., M. Phil., Ph. D.) or faculty from academic and research institutions working in the area of chemistry, chemical sciences and engineering, Bioengineering and material science, Biotechnology etc .</li></ul>
<b>Fees</b>	The participation fees for taking the course is as follows: <b>Participants from abroad : US \$500</b> <b>Industry/ Research Organizations: Rs. 10000</b> <b>Academic Institutions: Rs. 3000 (faculty); Rs. 1000 (Ph. D); Rs. 500 (B. Tech and M.Tech)</b> The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis, if available.

## The Faculty



**Prof. Sukesh R. Bhaumik** is from the Department of Biochemistry and Molecular Biology at Southern Illinois University School of Medicine (SIU-SOM) in U.S.A. He is also a Distinguished Scholar of SIU. He received his B. Sc. degree in Chemistry (Honors) with Physics and Mathematics from the University of Calcutta in 1990, M.Sc. degree from Indian Institute of Technology (Mumbai) in 1992, and Ph.D. degree from Tata Institute of Fundamental Research (Mumbai) in 1997. From 1998 to 2003, he carried out his post-doctoral research work at Howard Hughes Medical Institute at the University of Massachusetts Medical School. He started his independent research program as an Assistant Professor in the Department of Biochemistry and Molecular Biology at SIU-SOM in 2003, and promoted to Associate Professor in 2009 and Professor in 2017. He has 16 years of lecture-based teaching experience in USA in the areas of NMR, biophysics, basic and advanced biochemistry, medical biochemistry, genetics, molecular and cellular biology. He has also been teaching through problem-based learning method for last 12 years to the Doctor of Medicine students at SIU-SOM. Prof. Bhaumik is actively involved in research, has published more than 70 papers in high profile journals, and delivered 69 research talks. He has 28 years of research experience in the areas of NMR, structural biology, metabolism, enzymology, chromatin structure, gene expression and genomic integrity. His research program has produced many Ph. D. students, and has been continuously funded by various US funding agencies such as National Institutes of Health, American Heart Association, American Cancer Society, and Edward J. Mallinckrodt Foundation. In addition to his teaching and research, Prof. Bhaumik actively serves the scientific community as an Associate Editor of *GENE* (Elsevier), Academic Editor of *PLOS ONE*, Editorial Board Members of *DNA Repair* (Elsevier) and *Scientific Reports* (Nature), research grant review panel members of US National Institutes of Health and American Heart Association, and research grant reviewers of Canada, United Kingdom, Israel, Netherland, France, India, Poland, Croatia and Iceland. In addition, he also organized an Indo-US international conference on "Transcription, Chromatin Structure, DNA Repair and Genomic Instability" in Bangalore in 2018.



**Dr. Pamita Awasthi** is an Associate Professor at the Department of Chemistry at National Institute of Technology, Hamirpur (H.P.). She has 17 years of experience in teaching as well as research in the areas of designing and synthesis of biological active organic molecules, UV-Visible, IR and NMR spectroscopic techniques and In-vitro ligand-receptor spectrophotometric interaction techniques.



**Prof. A. S. Singha** is from the Department of Chemistry at National Institute of Technology, Hamirpur (H.P.). He has 33 years of experience in teaching as well as research in the areas polymer science and technology.

## Course Co- ordinator

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