



DNA Nanoarchitecture



Overview

With the advent of nanotechnology, a variety of nanoarchitectures with varied physicochemical properties have been designed and engineered. DNA is one of the emergig candidate for nanotechnology owing to its unique characteristics. The conceptual foundation for DNA nanotechnology was first laid out by Nadrian Seeman in the early 1980s with the words that, “It is possible to generate sequences of oligomeric nucleic acids which will preferentially associate to form migrationally immobile junctions, rather than linear duplexes, as they usually do”. Since then the field began to attract widespread interest. The use of nucleic acids is enabled by their strict base pairing rules, which cause only portions of complementary base sequences to bind together to form strong, rigid double helix structures. This allows for the rational design of base sequences that selectively assembles to form complex target structures with precisely controlled nanoscale features. Seeman and co-workers in 2009 have achieved a landmark by fabricating periodic DNA structure assembly using 3D DNA crystals that diffract X-rays to 4 Å resolution. This lead to realize that DNA building blocks could be used to assemble higher-order periodic/aperiodic lattices, and nanostructures. A number of methods are developed to use DNA scaffold for two- and three-dimensional lattices, folding structures using strand displacement techniques like nanotubes, mobius, polyhedra, and arbitrary shapes. Also, DNA based functional devices such as molecular machines and DNA computers are developed. Stapling of long and single DNA resulted in formation of DNA ropes. Enzymatic interlinking of single DNA blocks have been investigated for higher DNA structure. This unfolds the novel application of DNA to resolve basic scientific problems in structural biology and biophysics, including protein structure determination. Potential applications at molecular scale electronics and nanomedicine are also being investigated.

However, it is still infancy and various issues are yet to be addressed such as (i) thermal instability under moderate environments and (ii) restraint in size caused by the restricted length of scaffold strands. Alternatively, the enzymatic sewing linkage of short DNA blocks is simply designed into long DNA assemblies but it is more error-prone due to the undeveloped sequence data. The prerequisites is high intelectual and talent requires for complicated computer programing with fewer yields of products.

In this course the internationally acclaimed academics with prove record in the field will enlight the participants about the field, technological importance and stimulate discussions about the future of the field. The course will be planned and offered as per the set norms.

Objectives

The primary objectives of the course are as follows:

- Exposing participants to the fundamentals of nanotechnology, nanobiotechnology, and DNA nanotechnology.

- Letting the participant know about the synthesis methodologies and application of DNA nanotechnology and nanostructures.
- Providing exposure to practical analytical and characterization methods of DNA nanostructures.
- Discussing with the participants about the recent research publications in Nature/Science about the role of DNA nanostructures to increase their knowledge for establishing research in this new emerging field.
- Stimulate discussions about the future of the field.

Module/Brief Syllabus	<p>A: Duration : Feb 21- Feb 28, 2017</p> <p>B: Venu R.No.202, S. Ramanujan Block, Mujeeb Baugh, Jamia Millia Islamia, New Delhi 110025</p> <p>*No. of Participants for the course will be limited to fifty.</p>
You should attend If	<p>-PG, PhD student of nanoscience, nanotechnology, material science, biophysics, and biochemistry interdisciplinary basic science, nanobiosciences</p> <p>- Faculty Member, Researcher in the field of nanoscience, nanotechnology, material science, biophysics, and biochemistry interdisciplinary basic science, nanobiosciences</p> <p>- An executive, engineer and researcher from industry and government organizations, including R&D laboratories interested work in the area nanoscience, nanotechnology, material science, biophysics, and biochemistry interdisciplinary basic science, nanobiosciences</p>
Fees	<p>The participation fees for taking the course is as follows:</p> <p>Participants from abroad : US \$200</p> <p>Industry/ Research Organizations: Rs. 5,000/-</p> <p>Academic Institutions:</p> <p>Faculty members: Rs. 2000/-</p> <p>Master/PhD Students: Rs. 1000/-</p> <p>The above fee is towards participation in the course, the course material, computer use for tutorial and assignment, 24 hour free internet facility. The participants will be provided accommodation on payment basis, subject to the availability.</p> <p>Course Fees Payment: The DD should be prepared in favour of “Registrar, Jamia Millia Islamia”, payable at New Delhi and submit</p>

	G02, Office, Centre for interdisciplinary Research in Basic Sciences, S. Ramanujan Block, Mujeeb Bagh, Jamia Millia Islamia, New Delhi-4110025.
Registration	The participants should register on the following link: http://www.gian.iitkgp.ac.in/GREGN/index
Details of the course	<p>Feb. 20, 2017: Inauguration Ceremony : 11:00 am-12:00 noon</p> <p>Course introduction and interaction with Foreign scientist: 2:30 pm -4:00 pm</p> <p>Feb. 21, 2017</p> <p>10:00 am-11:30 am Lecture-1: Fundamentals of Nanotechnology, Synthesis methods and applications</p> <p>11:30 am-1:00 pm Lecture-2: Characterization techniques used in Nanotechnology,</p> <p>2:00 pm-4:00 pm Tutorial-1: Exposure of the participants to Characterization tools available in University (Central Instrumentation Facility and Centre for Nanoscience and Nanotechnology)</p> <p>Feb 22, 2017</p> <p>10am-11:30am Lecture-3: Fundamentals of Nanobiotechnology, Combinational Synthesis methods and applications</p> <p>11:30am-1:00pm Lecture-4: Characterization techniques used in Nanobiotechnology,</p> <p>2:00-4:00pm Tutorial-2. Exposure of the participants to Characterization tools available in University (Central Instrumentation Facility and Centre for Nanoscience and Nanotechnology)</p> <p>Feb. 23, 2017</p> <p>10am-11:30am Lecture-5: Fundamentals of DNA Nanotechnology,</p> <p>11:30am-1:00pm</p>

	<p>Lecture-6: Synthesis methods, characterization and applications of DNA nanobiotechnology,</p> <p>2:00 pm-4:00 pm Tutorial-3: Exposure of the participants to Characterization tools available in University (Central Instrumentation Facility and Centre for Nanoscience and Nanotechnology)</p> <p>Feb. 24, 2017</p> <p>10am-11:30am Lecture-7: Examples of various DNA nanostructure and their possible</p> <p>11:30am-1pm Lecture-8: Presenting a model Research Paper published in Nature/Science</p> <p>2:00pm-4:00pm Tutorial-4. An open group discussion on DNA nanotechnology</p> <p>Feb. 27, 2017</p> <p>10am-12:00noon Lecture-9: Sharing research experience on DNA nanostructures</p> <p>2pm-4pm: Lecture-10: Future applications for structural DNA nanotechnology</p> <p>Feb.28, 2017</p> <p>10:00am – 1:00pm Examination and Evaluation 2:00-3:00pm: Validatory Function</p>
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Faculty



Dr. Sung Ha-Park has obtained his B.Sc. and M.Sc. from California State University at Northridge, California, USA. He has also obtained MSc degree from University of Chicago, Chicago, Illinois, USA. He graduated (PhD,

2005) from Duke University, Durham, North Carolina, USA and joined as Post-doc fellow in Computer Science in Duke University, Durham, North Carolina, USA. Later in 2005, he moved to the Center for the Physics of Information, CALTECH, California, USA, as postdoctoral Fellow. Since 2008 he is working as Associate Professor in the Advance Institute of Nanotechnology, Department of Physics, Sungkyunkwan University. Since 2014, he is also associated to Department of Biomedical Engineering, Sungkyunkwan University. He is an Associate Editor, of ACS NANO since 2014. He has authored two papers that are published in *Science* (one of which has over 1400 citations), a paper in *Nature Nanotechnology*, four papers in *Nature Scientific Reports*, a paper in *Small* and number of papers in ACS Nano. Till dat he has total **26833 citations** with *h-index* of **60** and *i10-index* of **625** (Google Scholar). He has 15 papers with over 200 citation and 31 papers cited more than 100 times. His research interest is on the experimental bio and nano sciences including Structural DNA Nanotechnology, DNA Machine and Replicator, DNA Algorithm and DNA Computer, and DNA Device and DNA Sensor.

Dr. Z.A. Ansari, former Director and a Professor at Centre for Interdisciplinary Research in Basic Sciences (CIRBSc), Jamia Millia Islamia, New Delhi. She joined CIRBSc, Jamia Millia Islamia in 2007 as Associate Professor. She obtained BSc, MSc. and PhD from University of Pune, Maharashtra India. During PhD she worked on the optical properties of thin film for fabrication and applications of optical fibers/ waveguides. In 1999, she visited ICTP, Trieste for theoretical analysis of her PhD work. In 2000, she joined her post-doctoral fellowship at Inha University to work on the applied Nanoscience and Nanotechnology. In 2001 she moved to Chonbuck National University as a visiting professor to work on Scanning tunneling microscopy (STM) and electron microscopies, where she started her career in surface science. Later in 2002 she was selected as JSPS fellow and joined Japan Advanced Institute of

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Science and Technology (JAIST). After JSPS she was appointed as a faculty member in JAIST. In Japan she has extensively worked on surface science using STM, nc-AFM, FESEM, HRTEM and other microscopic and spectroscopic (XPS, Auger, EELS) techniques. Her research includes applied nanoscience & nanotechnology, biosensors and imaging techniques. She desires to develop the novel materials for sensing and energy conversion applications. To her credit two Indian patents are filed. She has over 80 publications in SCI listed peer-reviewed journals of high repute such as *Nature Scientific Reports*, *Phy. Rev. B*, *Applied Phy. Lett.*, *Langmür*, *Biosensors-Bioelectronics*, *Nanotechnology* etc. with ***h-index*** of ***17***, and ***i10-index*** of ***28***. She has has guided two PhD students and a few are working under her supervision. Her scientific contributions can be seen at http://jmi.ac.in/cirbs/faculty-members/Dr_Zubaida_Ansari-3194.