GIAN Course Title– Bio engineering and Mechanics of Materials

.....20th to 28th March

Overview

This course examples the wide variety of Bio-engineering options for students who plan to major in one of the undergraduate Engineering degree programs. The beginning lectures describe the science basis for bioengineering with particular emphasis on molecular cell biology and systems biology. Bioengineering faculty will then describe the bioengineering options in a particular engineering course as well as the type of research conducted by faculty in the department.

The synthesis of engineering and biology technologies results in major innovations in diverse areas, including developing imaging systems to help understand the origins of cancer and harnessing biomaterials for controlled drug release and tissue regeneration.

Students, professors, and researchers in biological engineering explore issues of physical and chemical sciences such as biochemistry, biophysics, pharmacology, and toxicology from both a molecular life science and an engineering perspective. Throughout the curriculum, our educational programs interweave biological imaging and functional measurement, bio molecular engineering and cell and tissue engineering, computational biology and bioinformatics, Metabolism of drugs and toxins. The course will be planned and offered as per the norms set by NIT-Trichy for Bio Chemical engineering subject.

Objectives

Major concepts of biological engineering with a number of important focus areas, including biological and physiological transport phenomena,

The primary objectives of the course are as follows:

It is unquestioned that cells can sense and respond to changes in loading. Increased load on focal adhesion sites in vascular smooth muscle, for example, can alter cell-signaling pathways, ultimately leading to altered gene expression. Altered gene expression can manifest itself in many different ways, including an altered production of vasoactive molecules, extracellular matrix and matrix-degrading proteins, cell cycle regulating signals, and cytoskeletal proteins, among many others. The net effect of these, and other, mechanotransduction pathways include increases in cell and matrix turnover, local growth (or atrophy), structural and functional re-modeling of existing cells, and re-modeling of matrix, cell-matrix and matrix-matrix interactions, all aimed, presumably, toward evolving the local mechanical environment from an undesirable' condition to a desirable' condition. Despite the explosion of information on tissue growth and remodeling, from molecular, intracellular, cellular, cell-matrix, organ, and whole organism levels, attempts at integrating these data into a predictive model is still in its infancy; there is a pressing need for such an integrative, multi-scale model. Such predictive models will be essential to further our understanding of many physiological and pathophysiological processes and critical to aid in the development and optimization of clinical interventions and tissue engineering strategies.

i) Exposing participants to the fundamentals of cell-signaling pathways, ultimately leading to altered gene expression

ii) Building in confidence and capability amongst the participants in production of vasoactive molecules, extracellular matrix and matrix-degrading proteins, cell cycle regulating signals, and cytoskeletal proteins, among many

iii) Providing exposure to predictive models will be essential to further our understanding of many physiological and pathophysiological processes

iv) Enhancing the capability of the participants critical to aid in the development and optimization of clinical interventions and tissue engineering strategies.

Course Details

Day		Date	Topic	Time	Details
0	Monday	20-03-2017		17:00 – 19:00	Introductions
				20:00 – 21:30	Dinner
1	Tuesday	21-03-2017	Overview of Energy and Materials Challenges	08:30 – 09:30	Registration & Inauguration
				09:30 – 13:00	**Lecture1:** Overview of global energy challenges; energy units; energy demand **Lecture2:** Energy and environmental challenges and potential of renewable sources **Lecture3:** Scientific & technological challenges
				14:00 – 17:00	**Hands-on exercise 1:** Energy and power units **Hands-on exercise 2:**Potential of renewable energy systems **Hands-on exercise 3:** Energy systems analysis problems
2	Wednesday	22-03-2017	Advanced Materials and Processing	09:00 – 13:00	**Lecture 1:** Introduction to Advanced Materials and Scalable Processing **Lecture 2:** Fundamentals of Thin and Thick Films Processing **Lecture 3:** Fundamentals of Processing for Nano scale Materials
				14:00 – 16:00	**Laboratory:** Aluminum anodization and fabrication of metal oxide nanowires- Examination using SEM
				16:30 – 17:00	Quiz 1
3	Thursday	23-03-2017	Physics and Chemistry of Advanced Materials	09:00 – 13:00	**Lecture 1:** Fundamentals of advanced materials science & engineering **Lecture 2:** Electronic and Optical Properties and Characterization Techniques **Lecture 3:** Structural characterization techniques
				14:00 – 16:00	**Laboratory:** Band diagram problems, wavelength, band gap, and light absorption calculation problems, equilibrium condition, biasing of junctions
				16:30 – 17:00	Quiz 2
4	Friday	24-03-2017	Photovoltaic and Thermoelectric Applications	09:00 – 13:00	**Lecture 1:** Photovoltaic device fundamentals and technologies **Lecture 2:** Thermoelectric and thermionic device fundamentals and technologies

					Lecture 3: Power device fundamentals and challenges
				14:00 – 16:00	**Laboratory:** Solar cell and thermionic device fabrication and characterization
				16:30 – 17:00	Quiz 3
5	Saturday	25-03-2017	Electrochemistry and Photo-electrochemistry	09:00 – 13:00	**Lecture 1:** Heterogeneous catalysischallenges **Lecture 2:** Electrochemistry fundamentals **Lecture 3:**Electro-catalysis challenges: electro-catalysts for oxygen/hydrogen evolution reactions and CO2 reduction, Oxygen Reduction Reaction **Lecture 4:** Fundamentals of photo-electrochemistry **Lecture 5:**Photo-electrochemical technologies
				14:00 – 16:00	**Laboratory Session:** Cyclic voltammetry Photo-electrochemical characterization of semiconductorsElectro-catalysis experiment
				16:30 – 17:00	Quiz 4
6	Sunday	26-03-2017	Fuel Cells	09:00 – 13:00	Fundamentals of Fuel Cells Materials for Fuel Cell Applications Microbial Fuels Cell
				14:00 – 16:00	**Laboratory Session:** Fabrication and Testing of hydrogen Fuel CellMe-OH Fuel Cell microbial Fuel Cell
				16:30 – 17:00	Quiz 5
7	Monday	27-03-2017	Electrochemical Energy Storage	09:00 – 13:00	**Lecture 1:** Overview of energy storage challenge and technologies **Lecture 2:** Overview of electrochemical energy storage fundamentals **Lecture 3:** Status and challenges of lithium ion batteries **Lecture 4:** Power conversion challenges: Capacitors
				14:00 – 17:00	**Laboratory:** Lithium Ion Battery and thermoelectric device testing and characterization.
8	Tuesday	28-03-2017	Biomass Conversion and Materials Genome Initiative	09:00 – 13:00	**Lecture 1:** Biomass and biofuels **Lecture 2:** Materials informatics techniques **Lecture 3:** Instructions on how to prepare for presentations
				14:00 – 15:00	Panel Discussion and Certificate Distribution and Closing Ceremony

Registration Fees

Modules	**A:Introduction of concepts, methods and tools: March 20 - March28** **B:Documented Laboratory Sessions: March 20 - March28** **Number of participants for the course will be limited to fifty.**
You Should Attend If…	▪ Practicing Engineers, Researchers from Industries, government organizations including R&D laboratories ▪ Students at all levels (UG/ PG/ PhD) or Faculty from reputed academic institutions and technical institutions
Fees	The participation fees for taking the course is as follows: **Participants from abroad : US $500** **Industry/ Research Organizations: 30000** **Academic Institutions: 10000** The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hour free internet facility. The participants will be provided with accommodation on payment basis.
How to Register	**Stage1:**Web (Portal) Registration: Visit GIAN Website at the link: http://www.gian.iitkgp.ac.in/GREGN/index and create login user ID and Password. Fill up blank registration form and do web registration by paying **Rs. 500**/- on line through Net Banking/ Debit/ Credit Card. This provides the user with life time registration to enroll in any no. of GIAN courses offered. **Stage2:**Course Registration (Through GIAN Portal): Log in to the GIAN portal with the user ID and Password created. Click on "Course Registration" option given at the top of the registration form. Select the Course titled "Bioengineering and Mechanicsof Materials from the list and click on "Save" option. Confirm your registration by Clicking on "Confirm Course". Only Selected Candidates will be intimated through E-mail by Course Coordinator. They have to remit the necessary course fee in the form of DD drawn in favor of "The Director, NIT, Tiruchirappalli – 620015" payable at NIT-Tiruchirappalli.
Accomodation	The participants may be provided with hostel accommodation, depending on the availability and on payment basis. Request for hostel accommodation may be submitted through e-mail to the Course Coordinator.

The Faculty

Dr. Rudy Gleason began at Tech in fall 2005 as an Assistant Professor. Prior, he prior was a Postdoctoral Fellow at Texas A&M University .Now, he is Associate Professor - Joint Appointment in the School of Biomedical Engineering, The George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia, USADr. Gleason's current research interest is in soft tissue biomechanics and growth and remodeling, with particular emphasis on native vascular tissues and tissue engineered constructs.

Dr. Diganta B Das (DBD) originally comes from Assam, India and studied in the National Institute of Technology (NIT), Jaipur, India for his Bachelor of Engineering (BE) degree in Chemical Engineering. At the moment, DBD is a Senior Lecturer of Chemical Engineering at Loughborough University (LU), UK. Prior to joining Loughborough, he was a faculty (Lecturer) at the University of Oxford between 2003-2007 and a Lecturer at LU (2007-09).

Dr. G. Arthanareeswaran graduated as a chemical Engineer in 1997. In 1999 he completed his Master's Degree in petroleum refining and petrochemicals and in 2005 he defended his PhD thesis at the Anna University, Chennai, India. His research interest involves development of polymer membranes for waste water treatment. From 1999 to 2001, he was a research associate of the A.C. College of Technology, Chennai, doing mainly research in membrane separation technology

Prof Anantharaman has completed B. Tech in Chemical Engineering at the Madras University in 1977.After finishing M.E in Chemical Engineering at IISc Bangalore in 1979, he completed Ph. D in 1985 in the field of Chemical Engineering at the Madras University. From 2006 onwards he is a professor at the department of Chemical Engineering National Institute of Technology, Tiruchirappalli. His research areas include three phase fluidization, treatment of Industrial effluents, liquid membrane separation. He has investigated many more research projects. Particularly, the projects investigated were modernization of unit operations laboratories sponsored by MHRD, India and studies on emulsion liquid membrane extraction sponsored by MHRD India.

Course Co-ordinator

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