



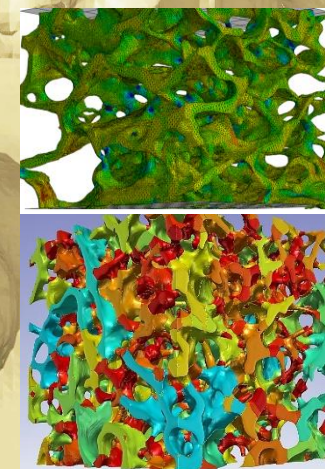
# A GIAN course on MECHANOBIOLOGY

May 24-28, 2017

Sponsored by: MHRD Govt. of India

Organized by:

Department of Mechanical Engineering  
Indian Institute of Technology Ropar



**Course Overview:** With the quantitative understanding of biological systems, new opportunities are now becoming available to understand and regulate biological processes to understand and treat various diseases and to use the biological processes in a controlled manner to engineer tissues and biomanufacture materials for a variety of applications. This is of particular interest for developing new products in healthcare and to develop advance materials using biomimetic principles. In this course the mechanical regulation of biological systems will be discussed. Topics include Principles and concepts of mechanobiology; Embryogenesis and histogenesis of tissues with particular references to skeletal system; Physical forces at cellular, tissue and organ level; Mechanical regulation of cellular behavior, tissue growth and organ development; Limits of mechanical regulation: Biochemical influences; Application of mechanobiology to tissue regeneration.

**Teaching Faculty:** Prof. Deepak Vashishth, Director of the Rensselaer Polytechnic Institute Center for



Biotechnology & Interdisciplinary Studies (CBIS), conducting breakthrough research on bones. His research interests are in the area of biomolecular science and engineering of extracellular matrix with particular emphasis on diagnosis and treatment of osteoporosis and bone tissue engineering. Prof Vashishth research group has identified new structural roles for bone proteins and developed new biomimicry-based strategies for tissue engineering scaffolds. He has published more than 200 peer-reviewed journal publications and conference proceedings in top journals including PNAS, Molecular and Cellular Proteomics, Langmuir and others. His work, presented in the form of more than 100 invited and contributed lectures, has been cited as a “New Hope for Osteoporosis Patients” and “Secret Formula for Bone Strength” in mainstream media. Prof. Vashishth is a fellow of the AIMBE and serves as Academic Editor for PLoS One and editorial board member for Bone and the Journal of the Mechanical Behavior of Biomedical Materials. He is a member of the Biomedical Engg. Soc., American Soc. of Bone and Mineral Research, American Assoc. for Advancement of Science, and the Orthopaedic Research Society.

**Host Faculty:** Dr. Navin Kumar is an Associate Professor and Head in the Department of Mechanical Engineering at



IIT Ropar. Prior to joining IIT Ropar, he was working as a Research Scientist at Stevens Institute of Technology, New Jersey, USA. He has completed masters in Mechanical Engineering from IIT Kharagpur and Ph.D. (Mechanical Engineering) from IIT Delhi. Dr. Navin Kumar's research interests are related to both theoretical and experimental aspects of mechanics and dynamics of nano, biological and bio materials and structures, Bone Properties Characterization, Biomedical Engineering, Biomechanics, Biomimetics. He has published numerous papers in international journal of repute.

**Course Details:** [Lecture = 15 Hours; Tutorials = 8 hours]

## Module A

Wednesday May 24th

**Lecture 1:** Basics of mechanobiology: Definition, relationship between form, function & Evolution from a skeletal biomechanics perspective

**Lecture 2:** Embryogenesis and Histogenesis of tissues

**Lecture 3:** Biomechanics of insects

Thursday May 25th

**Lecture 4:** Physical forces at cellular, tissue and organ level: Stress and Strain Analysis, Cellular, Tissue and Organ level forces and Strain histories.

**Lecture 5:** Mechanobiology of Articular Cartilage I: Formation, Growth and Development, Mechanical Regulation ECM remodeling (Tissue Level).

**Lecture 6:** Mechanical Characterization's of Biological Materials

Friday May 26th

**Lecture 7:** Mechanobiology of Articular Cartilage II: Mechanical Regulation chondrocyte behavior & function (Cell), Mechanical loading & Osteoarthritis.

**Lecture 8:** Mechanobiology of tendon and ligament: Formation, growth & development, Mechanical regulation and repair & replacement.

**Lecture 9:** Finite element based modeling of bone based on CT images

## Module B

Saturday May 27th

**Lecture 10:** Mechanobiology of Bone I: Formation, Growth and Development of Bones; Mechanical regulation of Ossification & Organogenesis of bone (Organ).

**Lecture 11:** Mechanobiology of Bone II: Mechanical regulation & adaptation of lamellar arrangement in bone (Tissue Level), mechanical regulation of bone cell(s) biology & function (Cell Level)

Sunday May 28th

**Lecture 12:** Concept and Application of Strain Energy Regulation in Biology: Mathematical model for growth and adaptation of Cortical bone, Continuum model approach to mechanically regulated remodeling of cancellous bone.

**Lecture 13:** Application of mechanobiology to tissue engineering: Cell cultures and mechanical perturbation, Cyclic compression vs Distraction osteogenesis. Case Studies involving bone-implant interfaces and limits of mechanical regulation

## Mode of Registration:

**STEP 1: One time web registration at GIAN portal**

(<http://www.gian.iitkgp.ac.in/GREGN/index>)

by making a onetime non-refundable payment of Rs. 500/-.

**STEP 2: Course registration:** After the mandatory web registration, Register on following

link after course fee payment: <https://goo.gl/m6hbeF>

Contact for help: [gianiitropar@gmail.com](mailto:gianiitropar@gmail.com)

## Course Fee Details and Process:

Student: 1000/-

Academic Institutions : 2000/-

Industry/Research Org.: 2000/-

Foreign participants: \$500

\*\*Participants have to submit his/her details with

amount transferred to Registrar, IIT Ropar. **Acc.**

**no: 30836125653;** IFSC Code: SBIN0013181;

Bank: SBI; Branch Name: IIT Ropar

\*\*Thirty five participants will be accommodated in IIT Ropar hostel on first come first serve basis on payment, the others will be accommodated in the nearby hotel.

## Course Coordinator

**Dr. Navin Kumar**

Associate Professor and Head

Department of Mechanical Engineering

IIT Ropar

Telephone +91 1881 242170 (Office),

+91 9501212380

Email: [nkumar@iitrpr.ac.in](mailto:nkumar@iitrpr.ac.in)