BIOMECHANICS

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PRE-REQUISITES : High school physics & mathematics. Kindly note that this course does NOT assume knowledge of Engg Mechanics and Strength of Materials.

INTENDED AUDIENCE : B.E./B.Tech (Biomedical Engg) students, M.E./M.Tech (Biomedical Engg) students, MS/ Ph.D.(Biomedical Engg) students

COURSE OUTLINE:

This course introduces Biomechanics to students from all backgrounds in engineering. The course builds a foundation in mechanics, introduces biological terminology and builds on this foundation to introduce static analysis, postural analysis and gait analysis. Further, this course discusses mechanics of biomaterials – both hard and soft tissues. Advanced concepts like Visco-elastic properties of soft tissues are also discussed. The course uses a novel pedagogical approach, the learner centric MOOC (LCM) approach.

ABOUT INSTRUCTOR:

Prof. Varadhan SKM is an Assistant Professor in Biomedical Engg at IIT Madras. His research interests are in the area of Neural control of movements, Motor learning, and Dexterous object manipulation in the presence of static and dynamic perturbations (See website for more details). He teaches courses on Biomechanics, Neuromechanics, Engg Mechanics, Biomedical Instrumentation, Quantitative Physiology.

COURSE PLAN:

Week 1: Introductory Mechanics – Statics and Dynamics – Basic Principles.
Week 2: The human body as a biomechanical system – basic terminologies
Week 3: Kinematics of muscles and joints - free-body diagrams and equilibrium, forces and stresses in joints
Week 4: Biomechanical analysis of joints of upper limb - Shoulder, Elbow, wrist, hand and fingers
Week 5: Upper limb as a mechanical system – analysis of reaching as movement of a multi-link serial chain – forward kinematics, analysis of fingertip forces as a parallel manipulator
Week 6: Biomechanical analysis of joints – Spine, Hip, Knee, Ankle.
Week 7: Introduction to Postural stability and Gait analysis.
Week 8: Gait analysis in health and disease - basics.
Week 9: Mechanics of Hard Tissues - Definition of Stress and Strain, Deformation Mechanics, structure and mechanical properties of bone - cortical and cancellous bones, Wolff's law of bone remodeling;
Week 10: Soft Tissues - Structure, functions, material properties – tendon function, elasticity in a tendon, models of non-linear elasticity in a tendon – physiological and non-physiological regimes, Davis' law of soft tissue remodeling.
Week 11: Visco-elastic properties of soft tissues, Models of visco-elasticity: Maxwell & Voight models.
Week 12: Basic Biofluid mechanics - Flow properties of blood in the intact human cardiovascular system.