**Biomechanics of Joints and Orthopaedic Implants**
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**Indian Institute of Technology, Kharagpur**
**Lecture - 01**
**General Introduction to the Course**

Good morning everybody, greetings from IIT Kharagpur. I welcome you all to the NPTEL online certification course on Biomechanics of Joints and Orthopaedic Implants. Now, the first lecture of the first module or week one that I will be presenting now is on the general introduction to the course.

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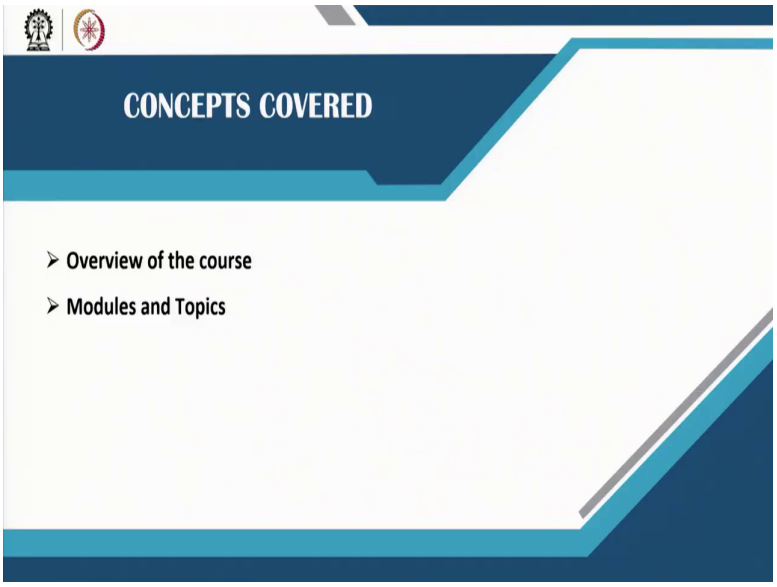


So, in this brief lecture we will be covering the overview of the course and the details of the modules and the topics discussed in each module.

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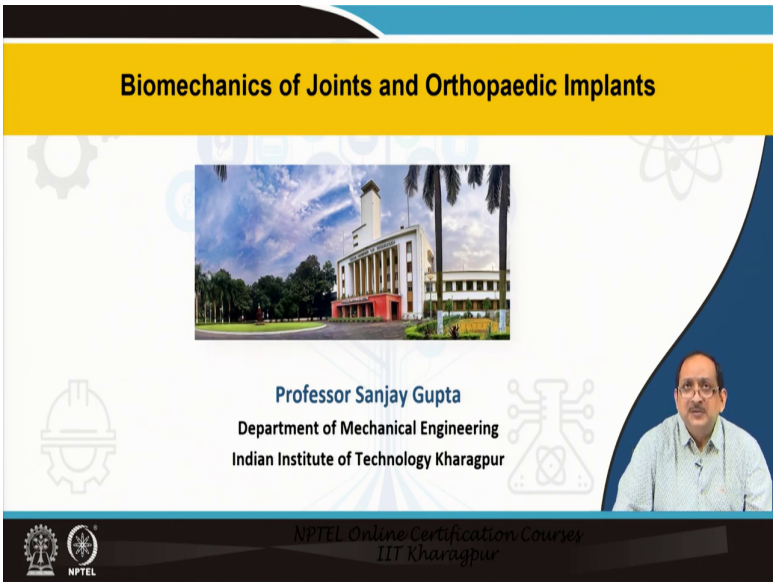


Now, the NPTEL online certification course on Biomechanics of Joints and Orthopaedic Implants is offered by myself professor Sanjay Gupta from the Department of Mechanical Engineering, IIT Kharagpur. I will be the principal instructor of this course assisted by my teaching assistants who are current PhD research scholars of the Biomechanics laboratory.

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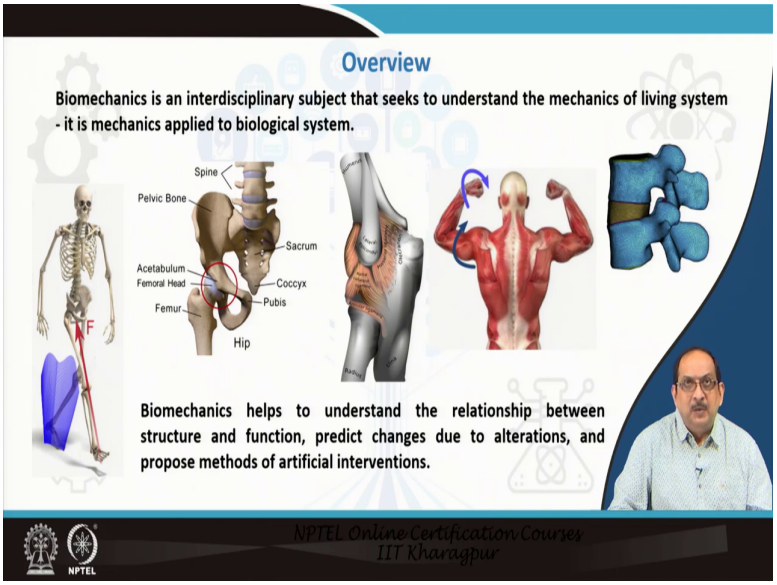


Biomechanics is an interdisciplinary subject that seeks to understand the mechanics of living system. It is the mechanics applied to the biological system. In this course, we would be

applying the principles of engineering mechanics to analyse the mechanical and structural functions of the musculoskeletal system.

The skeletal system of the human body resembles a machine that is capable of doing useful work together with the bones regarded as links joints and soft tissues. The skeletal system offers a large range of movement and transmit large forces from one link to the other. Biomechanics helps to understand the relationship between structure and function predict changes due to alteration and propose methods of artificial intervention.

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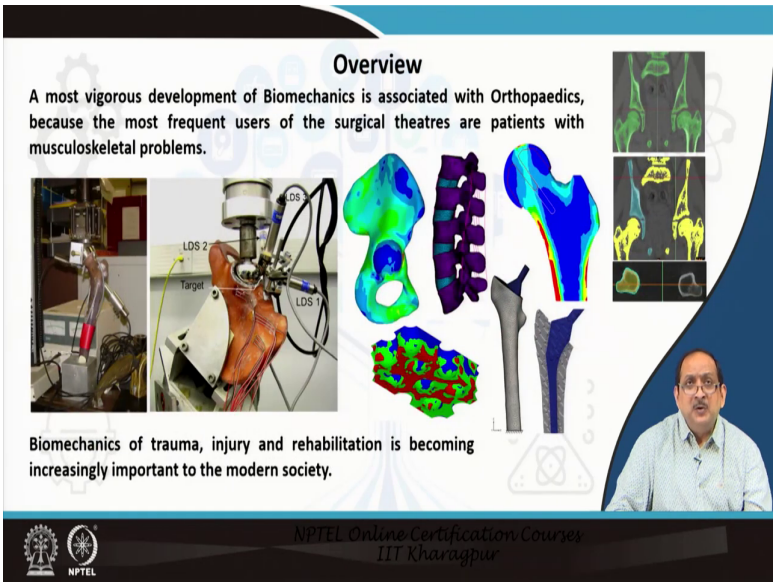


A most vigorous development of biomechanics is associated with orthopaedics. Because the most frequent users of the surgical theatres are patients with musculoskeletal problems. The subject deals with analysis and design of orthopaedic devices and implants that are frequently used to treat bone and joint diseases.

So, biomechanics of trauma, injury and rehabilitation is becoming increasingly important to the modern society. Thus, diagnosis, surgery and prosthesis are closely associated with biomechanics.

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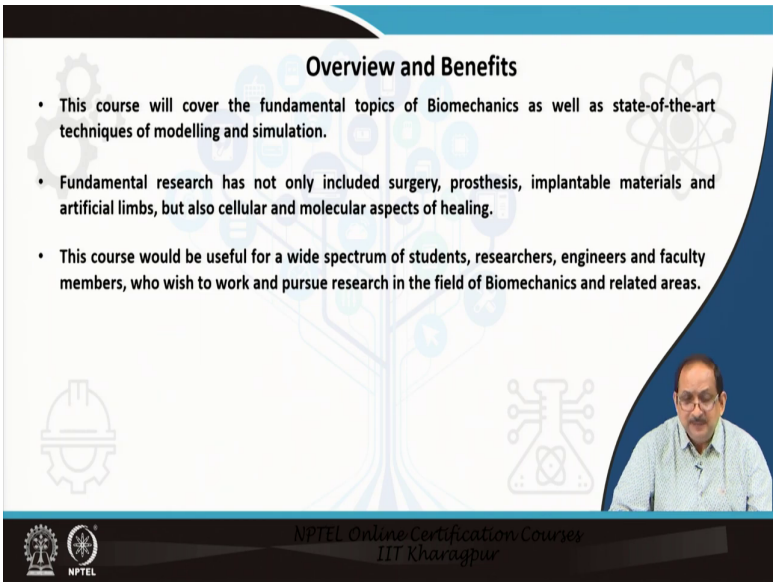


Now, this course will cover the fundamental topics of biomechanics as well as the state of the art techniques of modelling and simulation. Fundamental research has not only included surgery, prosthesis, implantable materials and artificial limbs but also cellular and molecular aspects of healing.

This course would be useful for a wide spectrum of students, researchers, engineers and faculty members who wish to pursue and work in the field of biomechanics and related areas. The course is designed for BTech, MTech and PhD students of mechanical, civil, biomedical engineering as well as medical students with special interest in biomechanics research. The attendees are expected to have basic knowledge in engineering mechanics and solid mechanics.

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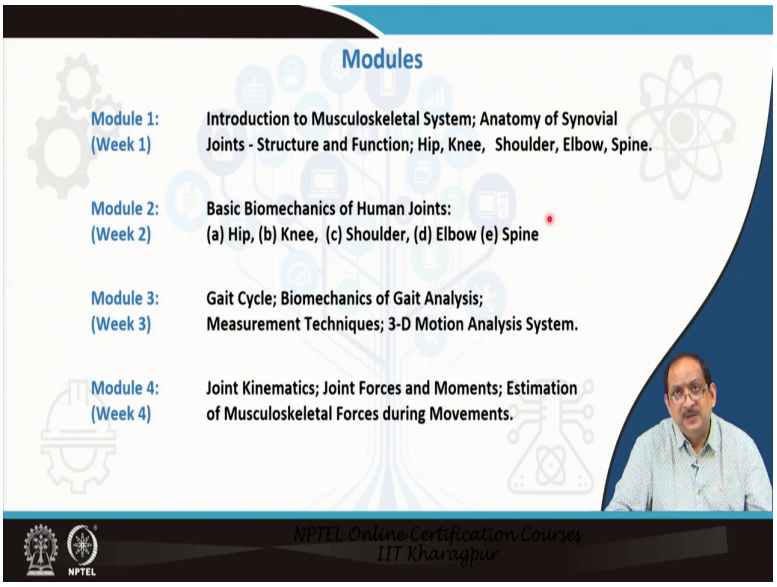


Let us come to the modules and the topics included in each module. The course will be covered in eight modules, it is an eight-week course, each module of approximately two and a half hours of lecture but this duration can vary from one module to the other. The first part of the course constitutes module one to module four will focus on the musculoskeletal system, human joints, human movement and joint kinematics.

Now, let us enter into the details of the module one. So, we will introduce the first module in week one, we first discussed about introduction to the musculoskeletal system, anatomy of the synovial joint including the structure and function in great detail we will visit each and every joint and discuss about the structure and function movements of hip, knee, shoulder, elbow and spine.

The module 2 consists of the basic biomechanics of the human joints. So, here we will discuss the basic biomechanics of hip, knee, shoulder, elbow and spine based on what we have discussed earlier in module one.

Basically, module one will be covering more on anatomy and movements of the joints whereas module 2 will be concentrating on the mechanics involved in the human joints. Module 3 in week 3 will consist of the following topics the Gait cycle and Gait abnormalities, biomechanics of the Gait analysis, the measurement techniques and the details of the 3D motion analysis system.

In the following module, that is module 4 in week 4 we will be discussing in great detail about joint kinematics, joint forces and moments estimation of the musculoskeletal forces during physiological movements or activities.

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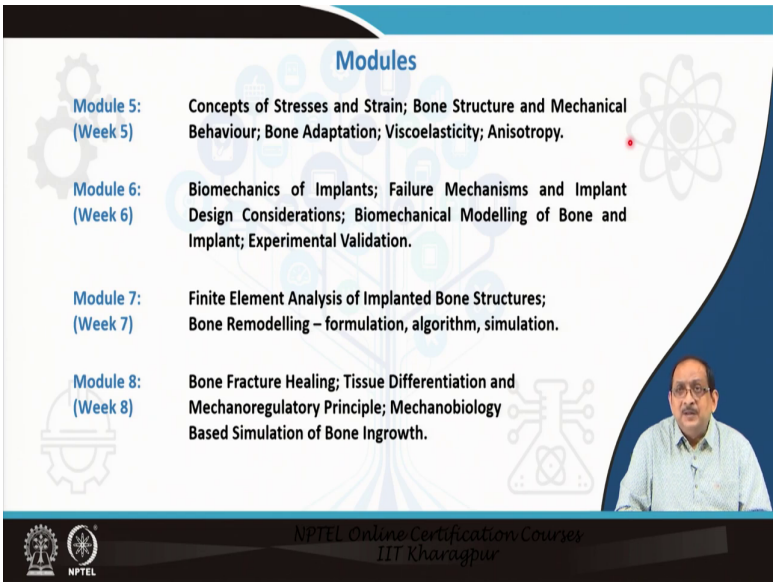


In the second part of the course, that is from module 5 to module 8: these modules will focus on bone structure and mechanics, total joint replacement, implant design and analysis, bone remodelling and tissue differentiation. The module 5 specifically will consist of lectures on concepts of stresses and strain, bone structure and mechanical behaviour, bone adaptation, viscoelasticity and anisotropy.

In Module 6, I will discuss about implants, biomechanics of implant, failure mechanisms and implant design considerations. We will consider a detailed biomechanical modelling approach of modelling bone and implants followed by experimental validation procedures that is required to validate the models or the results predicted by these models.

Module 7 will consist of finite element analysis of implanted bone structure detailed discussion on boundary modelling for consisting of formulation, algorithm development and simulation. Finally, in module 8 we will be discussing about bone fracture healing, tissue differentiation and mechanoregulatory principle, mechanobiology based simulations of bone ingrowth.

These application of these simulations to acetabular components and femoral components in hip replacement will be discussed in detail. I wish that all of you enjoy the course content and I hope that these lectures will be useful for advancement of knowledge in the subject biomechanics. I thank you for listening.