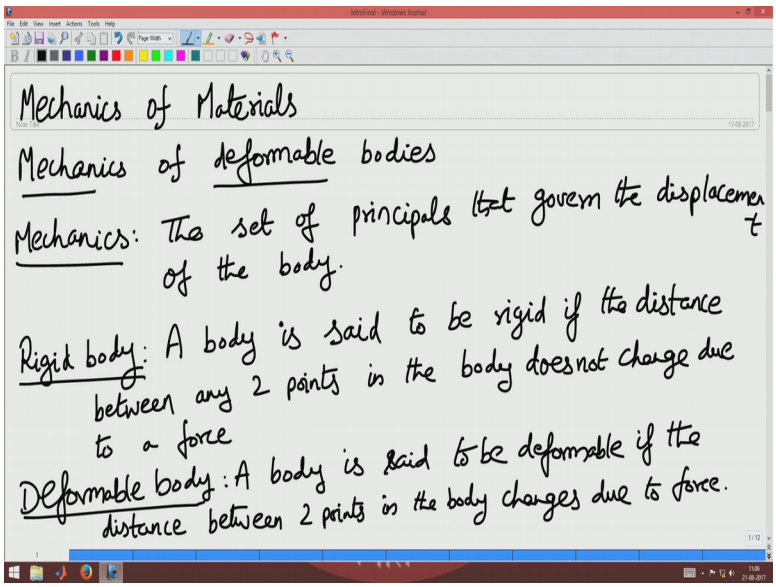
Mechanics of Material
Dr. U. Saravanan
Department of Civil Engineering
Indian Institute of Technology, Madras
Introduction and Mathematical Preliminaries

Lecture – 01
Part 1
Introduction to the course
Why this course?

Welcome to Mechanics of Materials course. This course in some universities is also called as strength of materials, but I find the most appropriate name for this course would have been mechanics of deformable bodies.

(Refer Slide Time: 00:27)



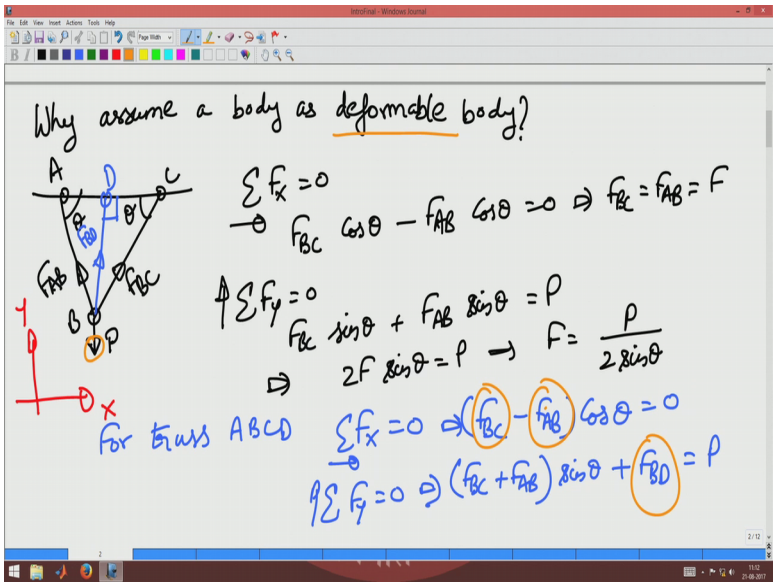
Here, I have used to terms one is mechanics the other thing is deformable let us understand what do they mean. First mechanics means the set of principles that govern the displacement of the body. You would have add previous course in mechanics called engineering mechanics where would have done with dealt with the mechanics of rigid bodies.

In contrast of the rigid bodies what we have going to look up now is deformable bodies. So, let us understand what do mean by a rigid body. A body is said to be rigid, is said to be rigid if the distance between any two points in the body does not change due to the application of due to a force. In contrast with this we have what is called as deformable

bodies where in a body is said to be deformable if the distance between two points in the body changes due to force.

So, what would have dealt in previous courses would have assume the body should be rigid and you would have analyze the bodies as rigid bodies and related the force and the displacement of the body directly. Vis a vis, in this course we have going to assume the body to be deformable and we are going to analyze a body as a deformable body.

(Refer Slide Time: 03:48)



Next let us understand why do you want to relax the assumption of rigidness of the body. Why assume a body as deformable body, why do you assume a body as a deformable body? And not retain the assumption that the body is a rigid one.

The reason is the following let us consider a plane two dimensional trusts of this geometry where let us say A B C are hinges and the angle at A is theta and angle at C is also theta you apply a force like this. At B now you can use a force equilibrium equations to determine what are the forces in this members F AB and forces in this member F BC from equilibrium equations right. Essentially you would have force in the X direction to be 0 wherein let us assume your X and Y directions are this, X and Y directions are this, then assuming this to be the positive direction positive X direction you will have F BC cos theta minus F AB cos theta to be 0 from where you get that F BC must be equal to F AB ok.

Next if you assume that the vertically acting force is positive and write a force equilibrium on the Y direction you will get F BC sin theta plus F AB sin theta that will be say this F BC and F AB was equal to F, so that should be equal to P which will imply that 2 times F sin theta was P and F is P by 2 sin theta. So, we have found the member forces F AB and F BC from simple equilibrium equations.

On the other hand now say I add another member and another member here which is B D. Now let us rewrite this equations, what will have is the first equation this is a 90 degree here the F X equation will remain the same for truss A B C D sigma F X equal to 0 would imply that same as before F BC minus F AB into cos theta must be equal to 0, but summation of the vertical forces would imply that F BC plus F AB sin theta plus F B D has to be equal to P where this is F BD.

So, now what happens? You have three unknowns and you have two equations. So, you cannot solve the three unknowns which are F BC, F AB and F B D using this two equations, these are linear equations so you cannot solve for three unknowns using two equations. So, you need some additional constraint. And this is where you have to assume that the truss is deforming. In other words if you apply a force P this point B would move down here right. So, you have to assume that this point moves down and then here do a set of calculations based on that assumption. Hence you have to assume the bodies deformable and not as undeformed, not as a rigid body. So, this is why it is important to understand how to analyze bodies as deformable bodies. So, we saw what a deformable is and what is mechanics.