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Structural Dynamics

Week 1: Module 01

Introduction to Structural Dynamics

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I welcome you all to this structural dynamics course in this module we will discuss about the structural dynamics that is an introduction to structural dynamics.

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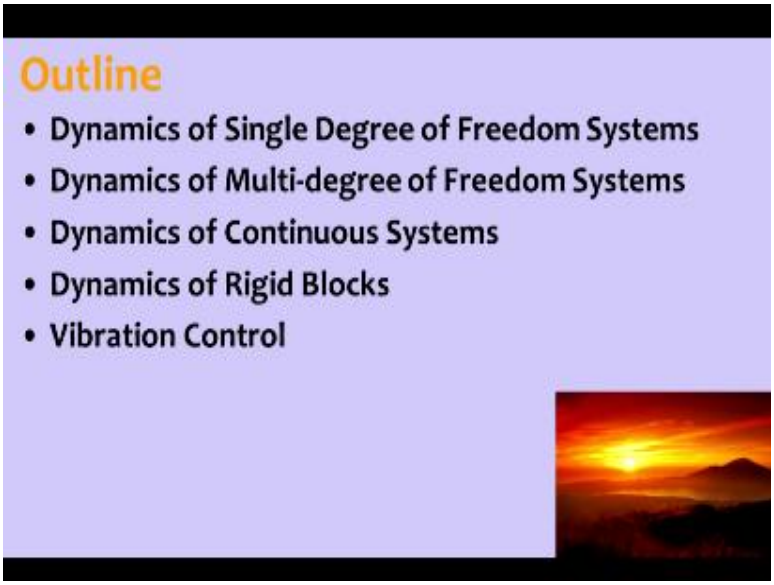

So the outline of this course is as follows so first we will discuss about the single degree of freedom systems dynamics of single degree of freedom systems and then dynamics of multi degree of freedom system as in like regular buildings and then where we cannot idealize systems

as a single degree or multi degree system is continuous for example say chimney okay or cell towers so we discuss the dynamics of continuous systems.

And then the systems which are rigid in nature rigid blocks okay so non structural elements are usually rigid in nature so where sometimes displacement is a critical issue and sometimes force is a critical issue so we discuss dynamics of rigid blocks and in some cases we need to control the vibration so we discuss so the outline of the entire course it goes as like this single degree multi degree of freedom system continuous systems dynamics of rigid blocks and vibration control these five elements are there.

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So now how this is spread in 12 weeks so in first week we will discuss about Free vibrations so in that we will discuss first the analysis types and then how to formulate stiffness matrix and what is the meaning of degree of freedom or kinematic indeterminacy so then will formulate equation of motion for a single degree of freedom system and then find out its solution so this equation of motion we have four categories in this free vibration force and vibration un damped free vibration damper free beverage so all those things will come.

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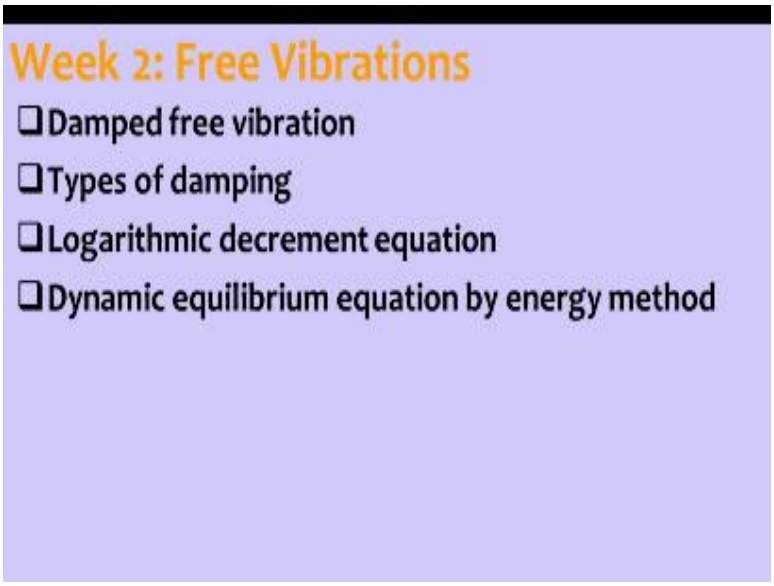

And in week two we will discuss damper free vibrations and what types of damping are present in the system and how the energy is removed from the vibrating system and what law it follows so that we are going to discuss in second week and then how to formulate equation of motion using energy principles that we will discuss in week two and in week three.

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Will discuss un damped forced vibration so when force is acting on the system and then if damping is present how this response of the structure is going to change and like when force is acting so in some cases there are special cases where forcing frequency and natural frequency of the system in both matches what kind of response is going to come out so that is resonating the responses so what is resonating displacement resonating velocity and resonating frequency we'll discuss.

And we'll apply this principles of single degree of freedom system indifferent applications so one such application is say if a vehicle is moving on the road and the road is imparting because of its are not smooth because of its bumps what kind of force is imparted onto the vehicle and what reactions like what how the vehicle is interacting with the road so that transmissibility will discuss in week 3 and.

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In week 4 okay all last week and second week third week we will discuss the dynamics using forces which are more or less sinusoidal in nature but in week 4we will discuss how to solve the systems where arbitrary force is acting on that so response to our prairie force respond to step force response to linearly varying force and response to a false excitation in addition to this one we will understand how a dynamic equilibrium equation can be solved in a using a Fourier transform methods and.

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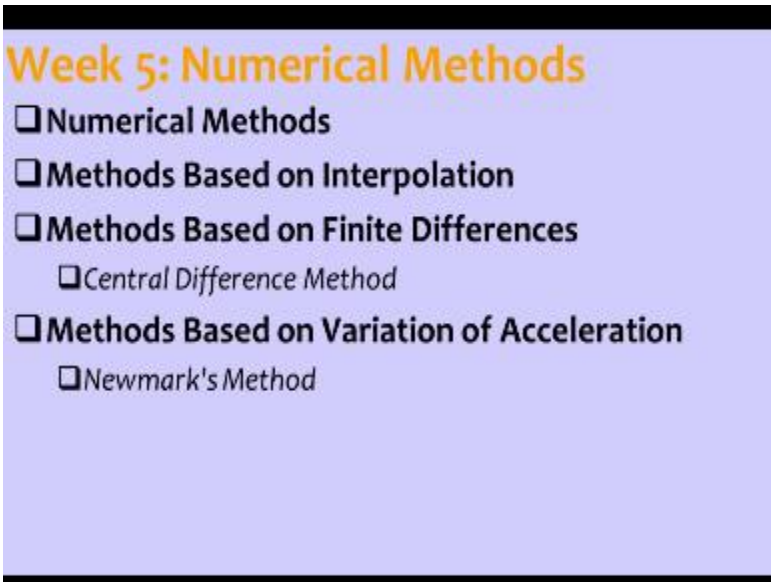

In week five we will discuss about numerical methods so numerical methods based on interpolation of the function and numerical methods based on finite differences and numerical methods based on variation of acceleration so in this we discuss two methods with example that is central difference method we will discuss and then New mark's method and week six will discuss response spectrum.

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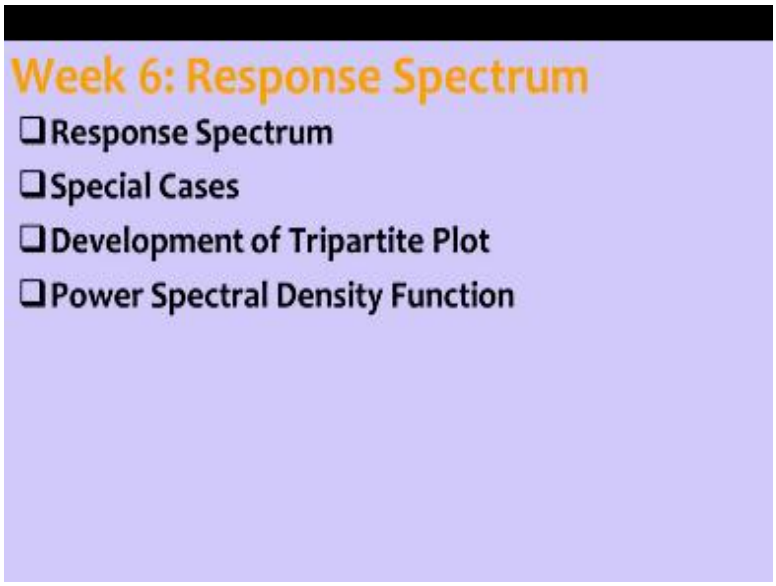

How a spectrum can be developed and oh the spectrum can be used for all engineering applications and the energy present in the vibrating system and energy present in input ground motion or input signal so those things will discuss in week six and.

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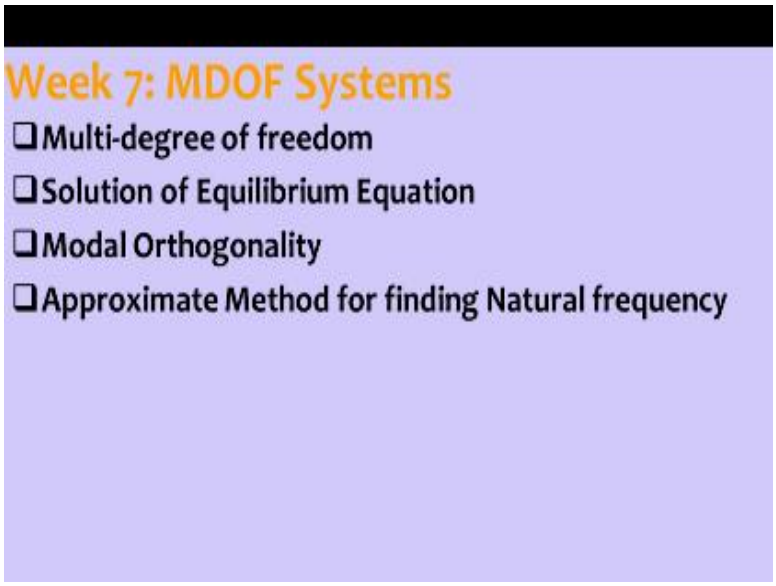

Week seven will go to multi degree of freedom systems so how to formulate equation of motion for multi degree of freedom system and how to solve it so modal analysis so how to derive the two important parameters which are natural frequency of the system fundamental natural frequencies and then mode shapes of the system and then what is the relationship between each mode shape so that we'll discuss and quite often it becomes that finding out the first fundamental a frequency is important.

So for that approximate methods to find out instead of going to TDS multi degree of freedom system calculations will discuss approximate methods for finding first natural frequency and in then next week

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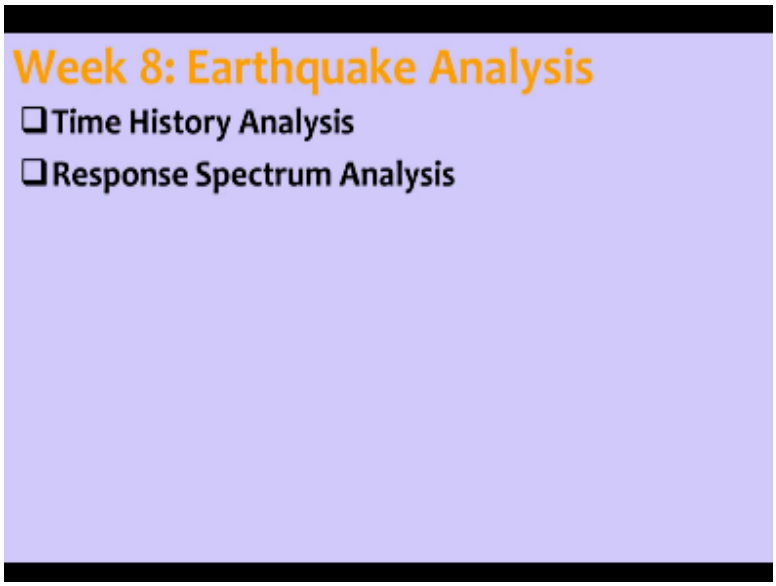

If multi degree of freedom system or irregular building is subjected to earthquake how do we get the response this has two components one is we can do time history analysis and get the response and other is the response spectrum analysis so we develop response spectrum of the given signal and use that response spectrum for finding the response of structure subjected to an earthquake and in week 9.

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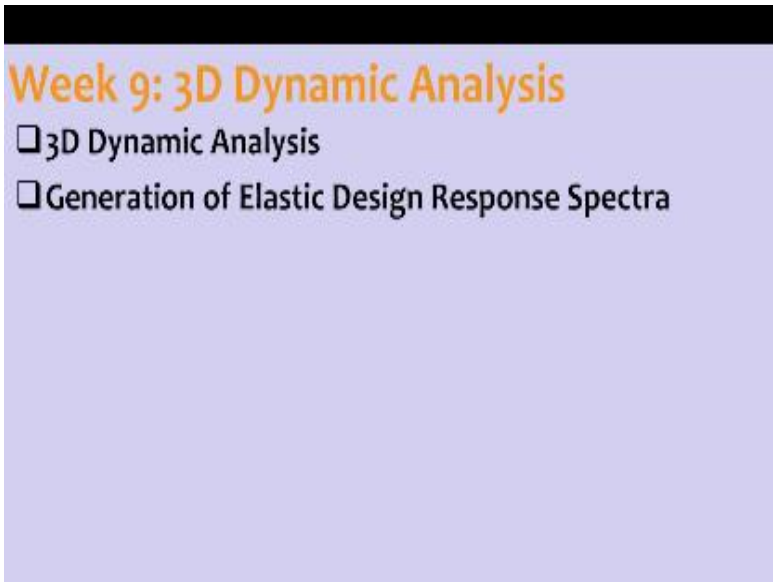

We will discuss 3D dynamic analysis or a regular building so how it oscillates into translational directions and the rotation in the like torsion so all these three put together how equations are going to change and how do we find the solution of that so this will be more realistic in nature and then later continuous system.

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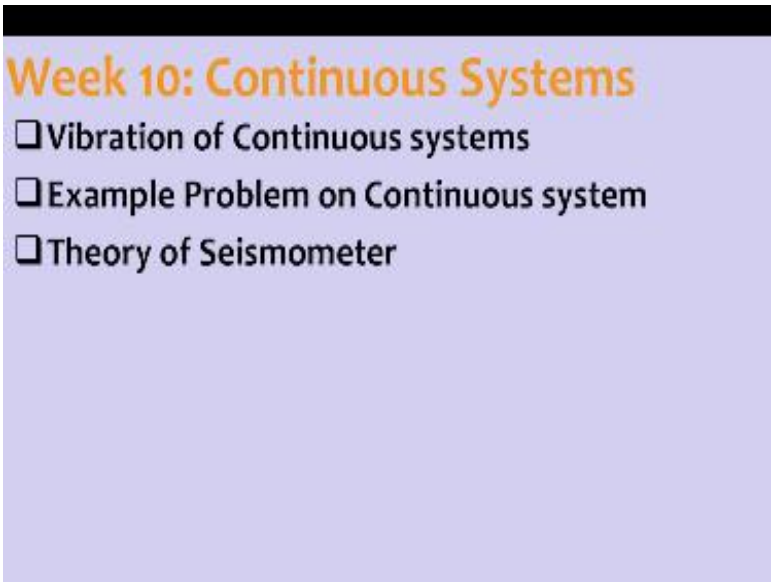

Vibration of continuous systems and then followed by that dynamics of rigid blocks or it is applications to non structural elements lastly we will discuss vibration control so how vibrations can be put underspecified limits so for that we have two broad categories one is active control and second one is a passive control some examples of active control how the input motion is fed to the system.

And then they have active a reduction vibration amplitude passive control in the form of base isolation dual mass damper so in these twelve weeks we will cover the entire course on structural dynamics starting from single degree multi degree continuous systems 3D read immune systems and vibration control

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