Computer Methods of Analysis of Offshore Structures
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Module - 03
Lecture - 04
Return Period & Stochastic Process (Part - 2)

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Now interestingly I have a question to ask.

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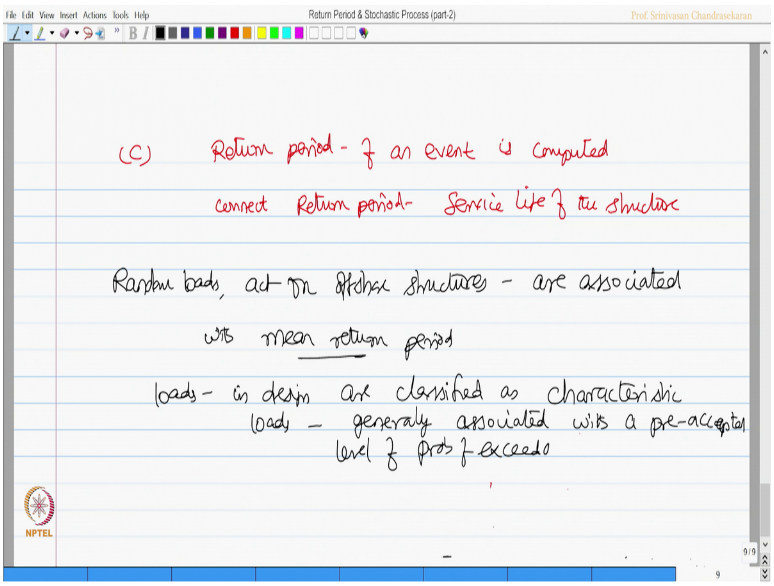

If the return period of an event is computed, I would like to connect the return period with the service life of the structure. In both, the earlier cases return period was connected either to the probability of exceedance of the event or it is connected to the risk level. We all agree that random loads act on offshore structures are essentially associated with something called mean return period. We also know that loads in design or classified as characteristic loads, which are generally associated with a pre accepted level of probability of exceedance.

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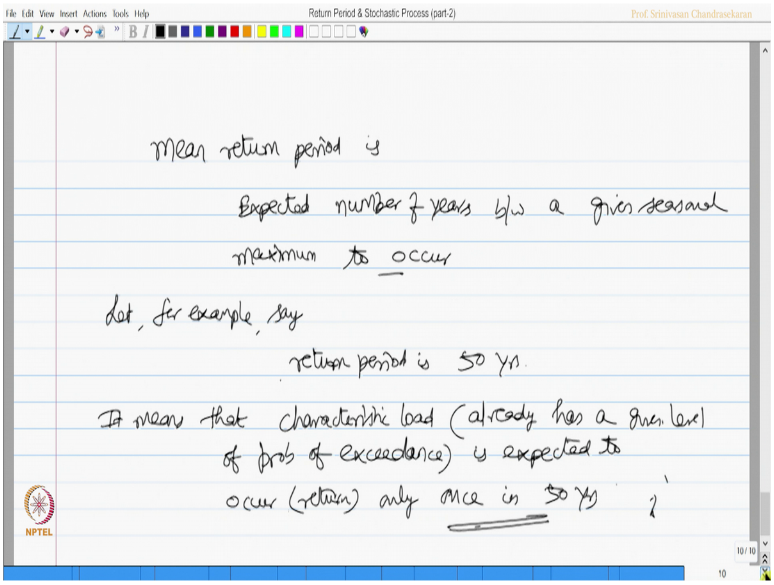

In that case the mean return period is expected number of years, between a given seasonal maximum to occur. Let us say for example, say return period is 50 years what does it mean? It means that the characteristic load which already has a given level of probability of exceedance.

Now, is expected to occur or let us say return only once in 50 years.

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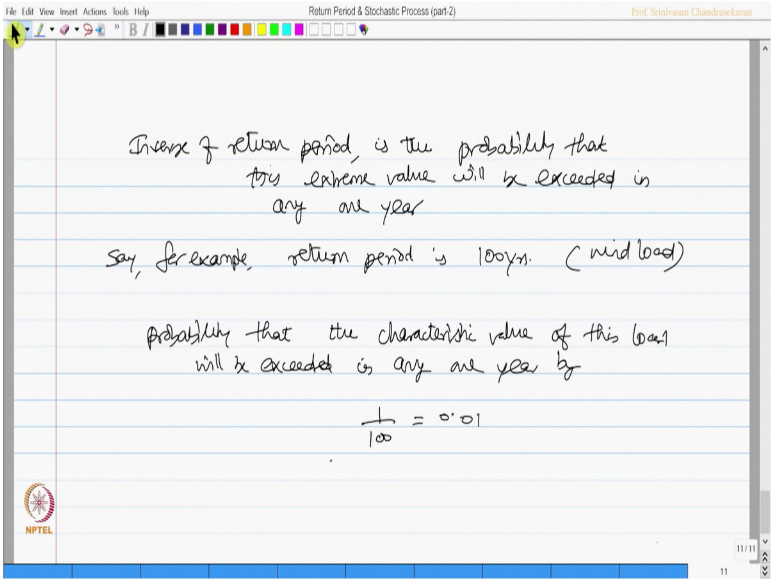

So, the inverse of return period as we saw in the last slide is the probability that, this extreme value will be, exceeded in any one year. Say for example, return period 100 years, say this is for wind load probability that the characteristic value of this load will be exceeded.

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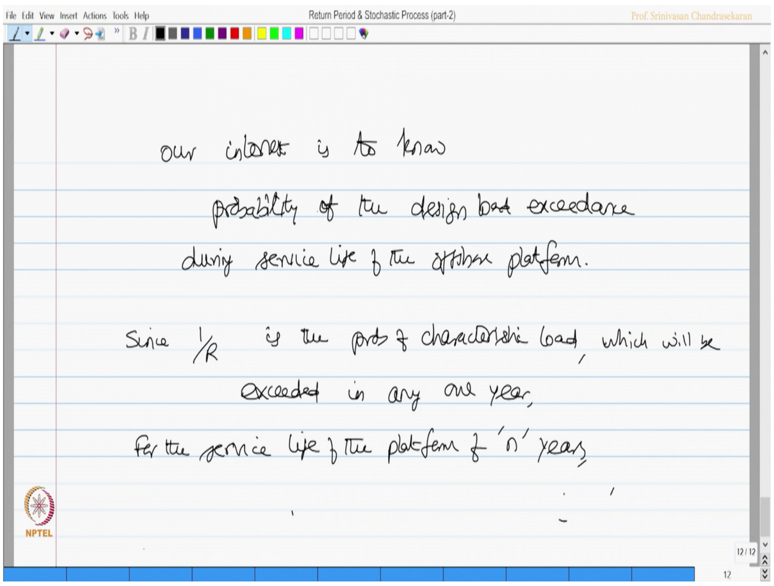

In any, but our interest does not our interest is to know the probability of the design load exceedance during let us say service life of the offshore platform. Now since 1 by R it is the probability of characteristic load which will be exceeded in any one year for the service life of the platform of small n years probability that.

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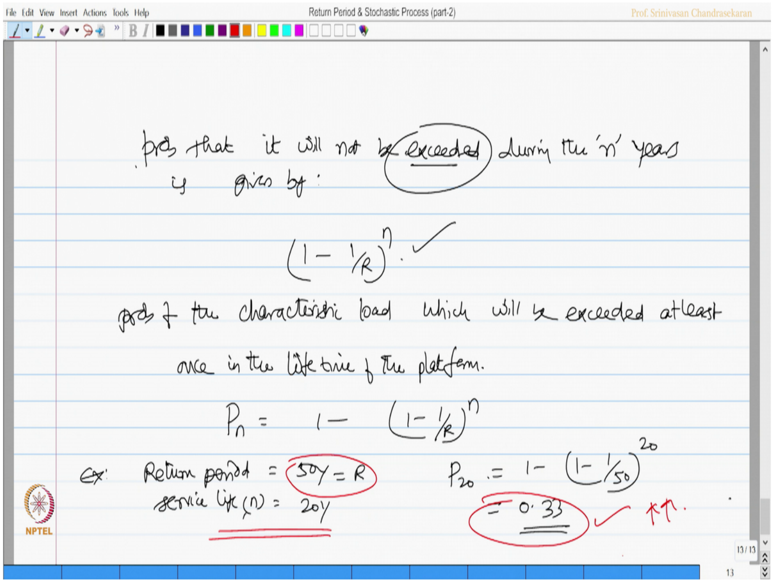

It will not exceed probability that it will not be exceeded during n years is given by this equation 1 minus 1 by R raised to the power n, where n is the service life of the platform. But we are not interested in this we are interested in estimating the probability of characteristic load which will be exceeded at least once in the lifetime of the platform. This can be given by Pn is 1 minus 1 by R to the power n. Let us take an example let us say return period of any event is about 50 years, service life of the platform small n is about 20 years this is actually capital R therefore, probability of 20 is 1 minus 1 by 50 raised to the power of 20 which comes to be 0.33.

So, friends it is very important to know that even though the return period his 50 years, which is far above the service life of the structure the probability of this load exceeding within service life is about 33 percent which is fairly a good number. So, it is very important in a stochastic process return period plays a very vital role in understanding the consequences of this value being exceeded within the service life of a given platform, this is much more important in design of strategic structures like offshore structures.

Having said this, will move our discussion further to understand the details about stochastic process more interestingly.

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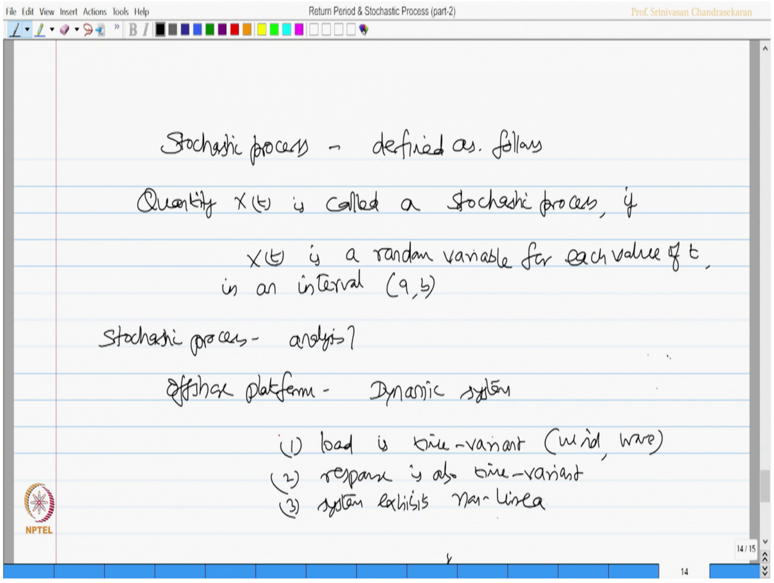

Let us now ask a question in general what do you specifically say by a stochastic process. Stochastic process can be defined as follows, quantity x of t is called a stochastic process if x of t is a random variable for each value of t, in an interval a and b. How stochastic process can be useful in analysis. Let us consider an offshore system or offshore platform which is essentially a dynamic system because of various reasons: one load is time variant like for example, wind load wave load etcetera to just now we saw response is also time variant 3 system also shows various nonlinearities.

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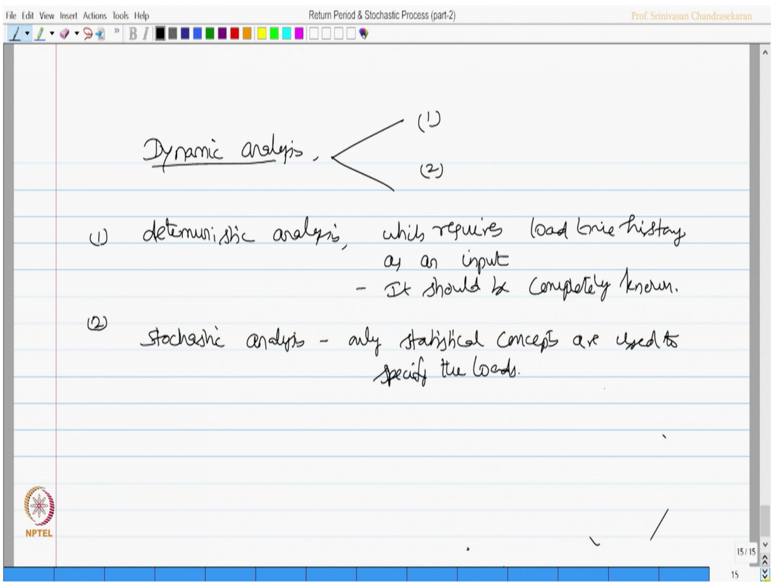

So, you want to perform the dynamic analysis. We have seen in different modules how to conduct computer methods for static analysis, but for a given dynamic system I want to perform dynamic analysis it can be done essentially by two ways. Firstly, one can do a deterministic analysis, which requires load time history as an input it should be completely known. Alternatively one can do stochastic analysis, where only statistical concepts are used to specify the loads. There are various examples of stochastic modelling which we will discuss in the next lecture, let us quickly see the executive summary of this lecture.

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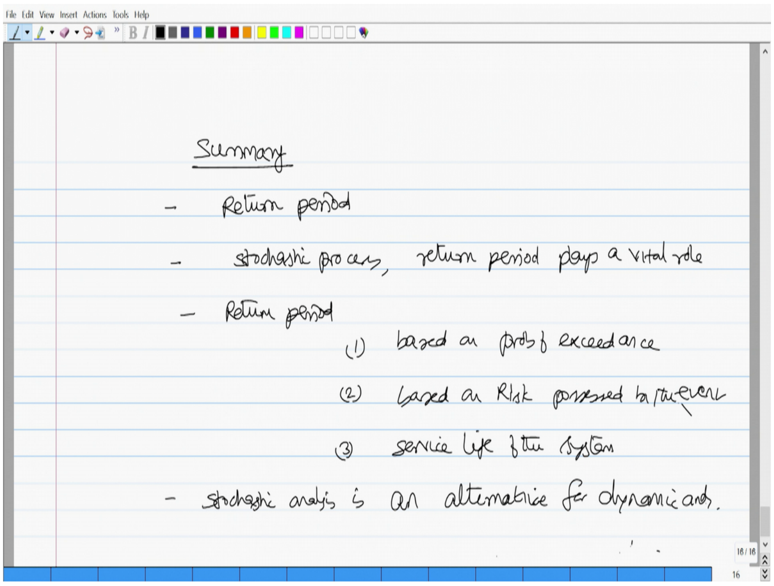

We learnt something about return period, we understood that for a stochastic process return period plays a vital role, we also said return period can be computed in three ways: one based on probability of exceedance of an event, two based on risk possessed by the event, also based on the service life of the system. We also understood that stochastic analysis is an alternative for dynamic analysis.

Since offshore platforms are time variant in the response and loads, dynamic analysis becomes important. Therefore, stochastic processes need to be understood which is aim and objective of this module of this course, where we will also give you some computer programs to estimate the fatigue failure based upon the stochastic processes.

Thank you.