

**Thermodynamics for Biological Systems:
Classical and Statistical Aspects
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**Lecture – 56
Thermodynamic Probability**

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The slide is titled "Thermodynamic Probability, W" and features the NPTEL logo in the top right corner. It contains two bullet points: the first states that the number of microstates corresponding to a given macrostate is called the "Thermodynamic Probability" or W; the second states that all microstates are equally probable, but the most probable macrostate is the one having the maximum number of microstates, i.e. having the most chaotic or randomized distribution => Most probable distribution!. Below the text, a handwritten equation in red ink is enclosed in a red box:
$$W = \frac{n!}{n_1! n_2! n_3! \dots}$$
 A photograph of Prof. Sanjib Senapati is visible in the bottom right corner of the slide frame.

The number of microstates corresponding to a given macro state is called the Thermodynamic Probability and that is denoted by capital W, and it is a very important quantity in statistical thermodynamics. The Thermodynamic Probability (W) can be written for, in general, for a system of n particles.

So, if you have a system of n particles (total number of particles) and let us say particles are distributed in different energy states as you know n_1 , n_2 and n_3 where n_1 is basically number of particles in energy state 1, n_2 is the number of particles in microstate 2, n_3 is number of particles in energy state 3 and so on and so on so forth. So, this W can be defined as

$$W = \frac{n!}{n_1! n_2! n_3! \dots}$$

So, this is the outcome of the definition of thermodynamic property which says that all microstates are equally probable, the number of microstates what we have seen for number of microstates for the second example. So, all microstates are equally probable but the most probable macro state is the one which is having the maximum number of microstates.

That is having the most chaotic or randomized distribution and that's the definition of most probability distribution. So, most probability distribution is the one where as number of microstates are maximum.