Thermodynamics for Biological Systems:
Classical and Statistical Aspects
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Lecture – 26
Learning Aspects

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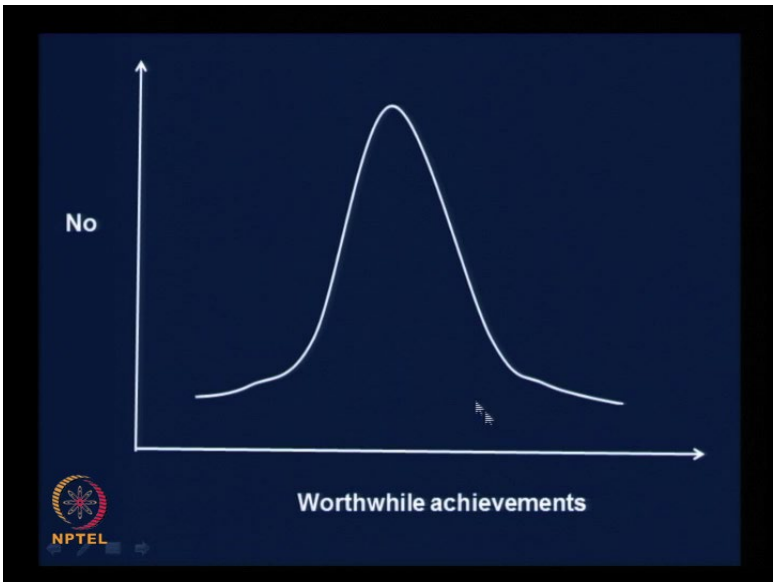

Welcome!

Today, let us began module 4, which is on thermodynamics of solutions. Before we begin the details of this particular module, I think it is high time that we talked about the class itself. I have been presenting the material at a particular level to the class, and I am sure some of you have gotten bored with the extent of detail that is been presented – a small number, that is. And some may have found it difficult to follow what has been happening.

If you look at the number of students – this is, in terms of worthwhile achievements. I have been kind of careful and picking out this word …, these set of words, `worthwhile achievements', because … the performance in examination, whether it is worthwhile or not, is debatable. What I mean by worthwhile achievement is the level of understanding that you have, the comfort level that you have with the information, the confidence with which you could apply this information to real world situations, and so on and so forth.

If you look at worthwhile achievements such as those, on the x axis … this definitely includes the performance in the examinations, but not necessarily so. For example, certainly people who are good would perform well in examination also; … good, in the appropriate skills would perform well in the examinations also. But the lack of examination performance does not preclude people having some of these skills.

If you look at the worthwhile achievements here on the x axis – this being high and this being on the lower side – in a class of a reasonable number, may be about 30 or above, we distinctly find this normal distribution. Please assume that this is a normal distribution – this is some sort of a, you know, freehand sketch. Sometimes it is slightly skewed to one side, and so on and so forth. But, by and large, this is valid.

What this says is, most people in a class are somewhere in the middle, and there are some people who are very high achievers in terms of worthwhile achievements. And some, here, who would need a lot of help to achieve … to get to a certain level of achievement. What I normally do is teach my courses at this level. It is very easy to teach courses at this level, because we already know the material, but that is not being fair. So, I try to teach at this level. And, in this course particularly, I felt that the majority of the students have a shown much better inclination to the class, much better interest in the class, if they know the basis of the information, the equations that we come up with and so on. That is a reason, why we spend quite a lot of time on those … the details of those derivations.

In any case, I tend to teach to people, here. So, if you have been comfortable in the course you know where you are. For people, here, in regular class i.e. in a classroom, I have different means of handling them, which broadly fall under the ambit of cooperative learning. I pair them up with other students who probably are on this end, and thereby these people pick up and perform to a certain level.

Here, for people here, these people are the ones who are expected to contribute significantly to the improvement of aspects of the field, and improvement of aspects of certain relevant things which relate to this course, and so on and so forth. Or, any course for that matter. So, some attention is paid to these people also. But, as a class each one is important.

If you look at the western literature, Bloom's taxonomy and so on and so forth. According to Bloom's taxonomy, there are supposed to be six levels of learning. I think it is knowledge, it is comprehension, it is application, analysis, synthesis and evaluation. If I remember those six things

correctly; sometimes … of late there have been some changes in the hierarchy of the last two things, and so on and so forth. This is the way Bloom has seen it in his taxonomy. … Many people see it even now, in terms of a student getting to various levels of learning across these six levels, upward.

If you read some of our literature … I have read some by Sri Aurobindo. … His views do not conflict with whatever is … whatever I have said just now in terms of Bloom's taxonomy, but, it goes beyond that. He says that the role of a teacher is essentially to point out, not even to bring forth. The `bring forth' has probably been the meaning of the term education – to educe, and so on and so forth. Sri Aurobindo says it is not even to bring forth, it is juts to point out to the student the latent aspects in a student and allow it to rise to the surface. Which I feel is a very complete way of looking at things.

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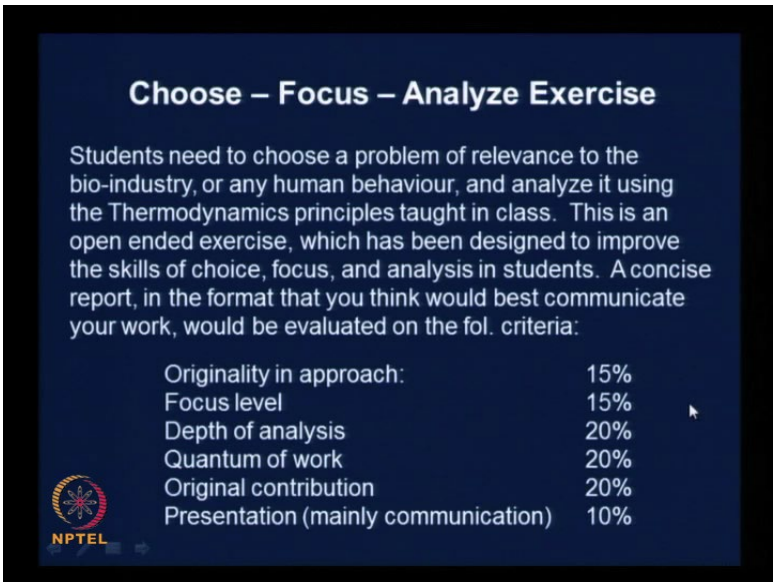

To cater to these people or this part of the population, in this particular course, let me give you an exercise, the choose, focus, and analyze exercise. This exercise is typically assigned, so that you could spend a few months on that exercise, I typically assign it in the beginning of the class. In this case, since this is a different kind of a course, I am assigning it here. Let me first tell you what this exercise is all about. Let me read it out from here: … students need to choose a problem of relevance to the bio-industry; need not be necessarily limited by that – it could be relevant to any human behavior or endeavor – and analyze it using the thermodynamic principles taught in class. This is endeavor, human endeavor, and analyze it using the thermodynamics principles

taught in class. This is an open ended exercise, which has been designed to improve the skills of choice – it is a very difficult to develop – focus, and analysis in students. And a concise report in the format that you think would best communicate your work would be evaluated on the following criteria.

Originality in approach 15 percent, focus level is 15 percent, depth of analysis 20 percent, quantum of work 20 percent, original contribution 20 percent, presentation which is mainly communication about 8 percent and 2 percent for the professional appearance of the report will carry 10 percent. … This criteria, I usually strictly follow. Let me assign this to you. Let me see if you feel bored with some aspects the course, whether you can fulfill you potential and do an exercise of this sort. Once you do the exercise you can always get back to me and let us discuss that.

See you in the next class.