Teaching and Learning in Engineering (TALE)
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Lecture - 20
Attainment of POs and PSOs

Greetings and welcome to the Module 1 Unit 20 which is related to attainment of Program Outcomes and Program Specific Outcomes.

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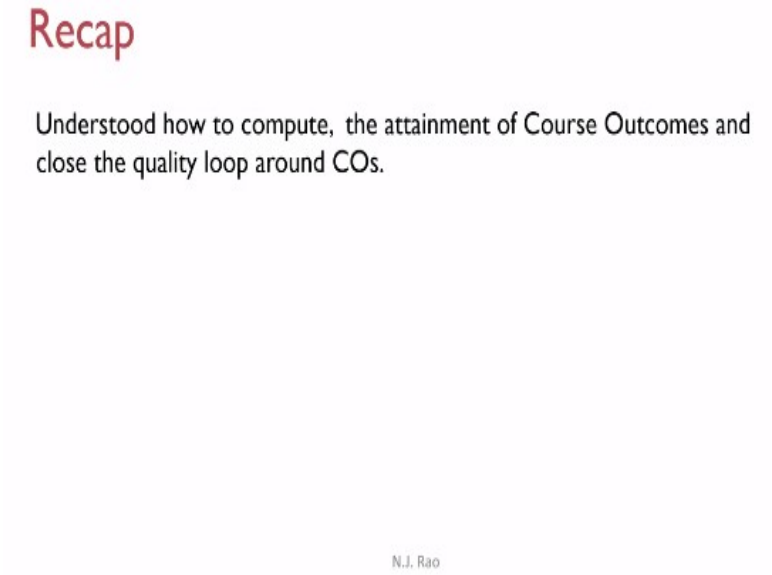

In the earlier unit we understood how to compute the attainment of Course Outcomes and close the quality loop around the COs. And that is the prerequisite to move towards computing the attainment of Program Outcomes and Program Specific Outcomes.

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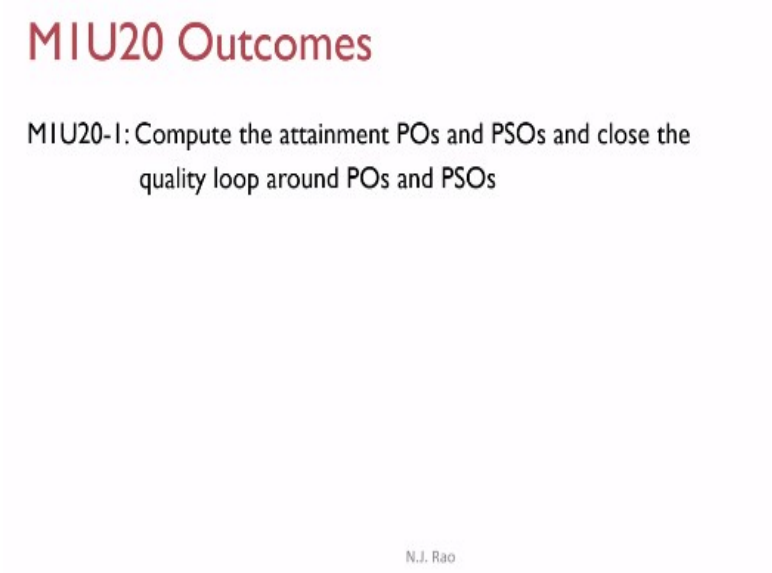

And this unit will focus on computing the attainment of POs and PSOs and close the quality loop around POs and PSOs. One thing needs to be remembered as we go up from Course Outcomes, courses to the program, the whatever we have attained at the course level we are trying to take it towards in terms of what we have attained at the course level we are trying to determine the attainment of POs and PSOs. And POs and PSOs are attained through so many activities.

That means computing attainment of POs and PSOs requires considerable amount of aggregation over all the activities or majority of the activities over the 4-year duration of the program. So to that extent the way you aggregate is not necessarily unique. And there is no one correct way of doing things.

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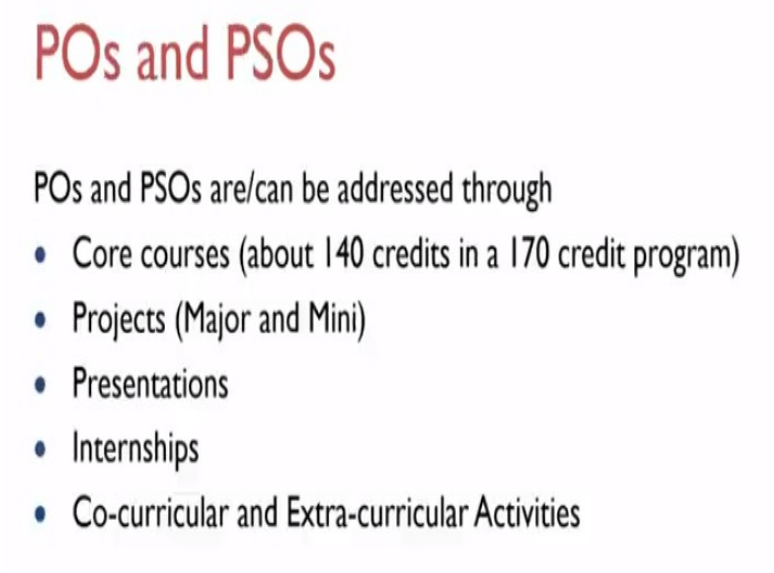

One has to be a little careful in terms of over specifying or under specifying the aggregation process. So let us look at POs and PSOs or and also can be addressed through core courses. As you can see as of today, the core courses constitute almost 140 credits out of 170 credit program, any undergraduate program. This will include, this 140 credits will also include the project or projects.

And so in addition to core courses we have projects, presentations, internship, co-curricular and extra-curricular activities. All of them can be can be used or can be they can be aggregated to determine the attainment of POs and PSOs.

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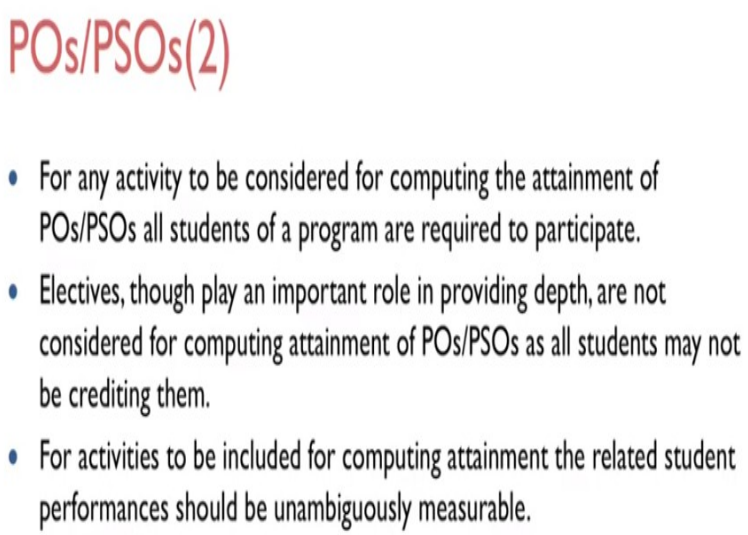

But for any activity to be included in computing the attainment of POs and PSOs it is necessary that all students participate in the identified activity. If they are not then obviously you cannot say that all students have attained the program outcomes. For example electives, they play very important role in providing depth in some direction in all programs but they are not considered for computing the POs and PSOs as by the very nature electives are not taken by all students.

Same elective will not be taken by all students. And another feature is for again for this aggregation any activity to be included for computing attainment, the performance of the students related to that activity should be unambiguously measurable. Sometimes the performance is like a written examination where you can value the performance or sometimes like presentations or projects you need to define a set of rubrics which are again are to be or can be unambiguously be measured.

So these are the two properties. All students should participate in the activities to be included for computing the attainment of PO and PSO as well as the rubrics and evaluation procedures should be very clearly defined.

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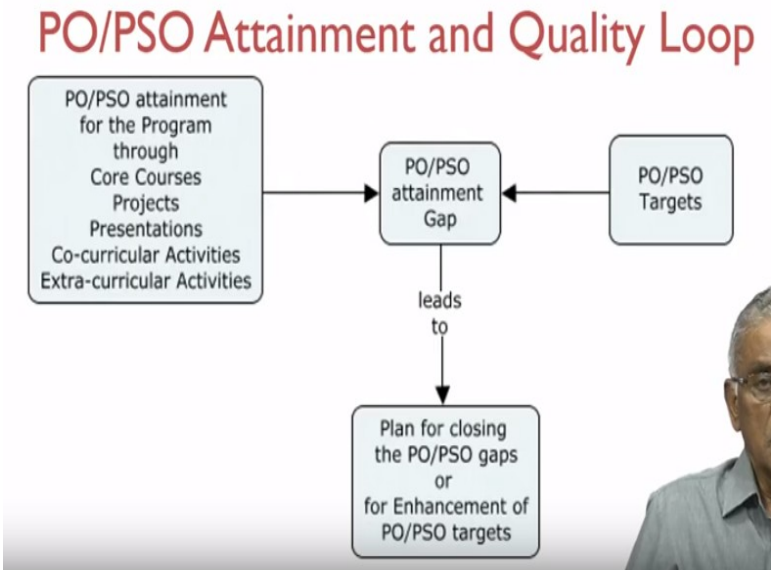

Here we are making this look somewhat simple. The PO/PSO attainment of the program through courses, core courses, projects, presentations, extra-curricular activities, or co-curricular activities they you compute the PO attainment and then you also set PO/PSO targets if you look

at the PO/PSO targets are set and the difference between the two is the attainment gap and that should lead to a plan for closing the PO/PSO gaps or enhancement of the targets.

We are not showing the feedback loop around this to here or around this to here. That is implied. So this is the relationship for closing the loop around PO/PSO. For example how is the PO/PSO attained? It is attained through various activities that we have already listed.

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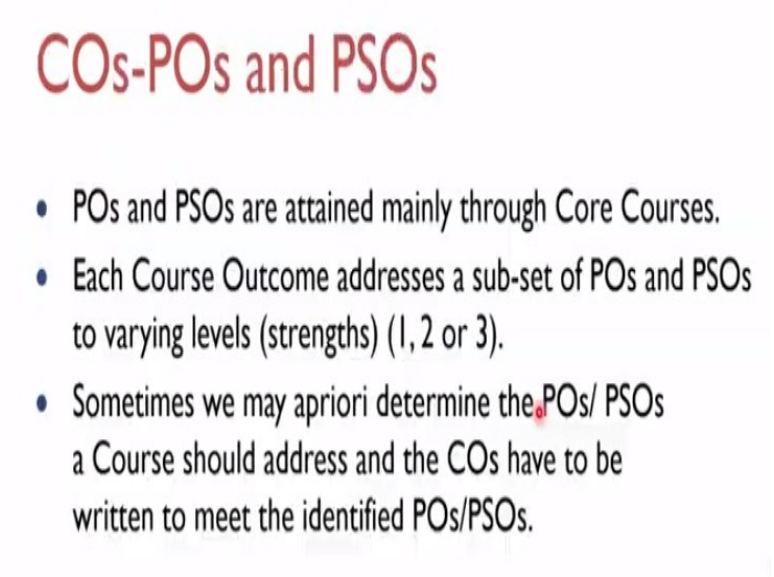

And as we said POs and PSOs are attained mainly through core courses because they constitute the significant percentage of activities in an undergraduate program and what happens is if you look at any one course and also each Course Outcome of that course, each Course Outcome addresses only a subset of POs and PSOs. And to varying levels or what we call strengths.

For example I may be slightly addressing a particular PO or I may be addressing a PO moderately because if you read the PO there are every PO has several key phrases. And what happens when you look at a particular Course Outcome, all the key phrases may not be applicable to that particular stated outcome.

So what would happen, depending on which are the key phrases it is focusing on or how many it is focusing on we can associate a strength to which the course outcome is mapped on to a given PO or a PSO. So here we just identify three levels; 1, 2, 3; 1 means slightly, 2 means moderately,

3 means significantly. In addition to this, when we do all these we may find certain POs are not adequately addressed by the program.

In that case, the department will have to look at all the core courses and decide a set of identified courses will have to address our the whatever we want the kind of POs and PSOs we want to address. So to that extent we may apriori determine the POs and PSOs a course should address and the COs will have to be written to meet this identified the POs and PSOs. This is unlikely to happen when we first operate under the OBE.

Because we are starting from where we are and it is very rare that we define POs and PSOs and write COs. But that may be required let us say when you do a second iteration over designing your courses.

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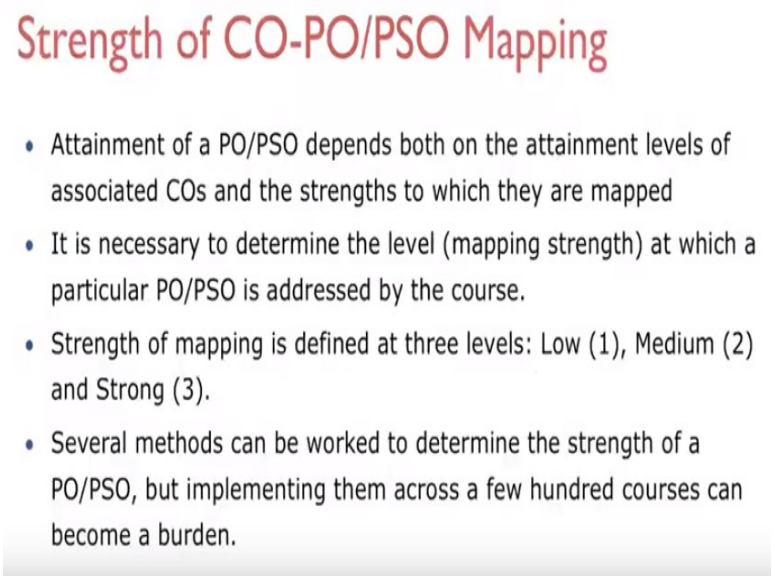

The attainment of a PO or a PSO depends on the attainment levels of associated COs and the strength to which it is mapped. There are two variables. One is to what extent COs are attained and the other one is the strength to which that CO maps on to POs. These are the two variables you can say. So first thing is it is necessary to determine the level of or mapping strength at which a particular PO or PSO is addressed by the course.

As we said the mapping strength is defined at 3 levels; low, medium, strong or 1, 2, 3 like that. And this is where there exist any number of methods to determine the strength of a PO/PSO. If you do not provide any method it is very very sometimes either intuitive or sometimes even arbitrary saying that I just merely say I address a PO to the strength of 3 or 2 like that.

So we need, and what happens when it is done especially over a few hundred courses in a program, in an institution it becomes the activities become not adequately comparable and really they do not serve the purpose. So what should happen is one method should be followed by followed for all programs in an institution. And once again we give one method which after testing out with several faculty, which was found to be reasonable to all the participating faculty; but you can always redefine after discussing with others saying that you would prefer to map the strength of a particular CO to PO in your own way.

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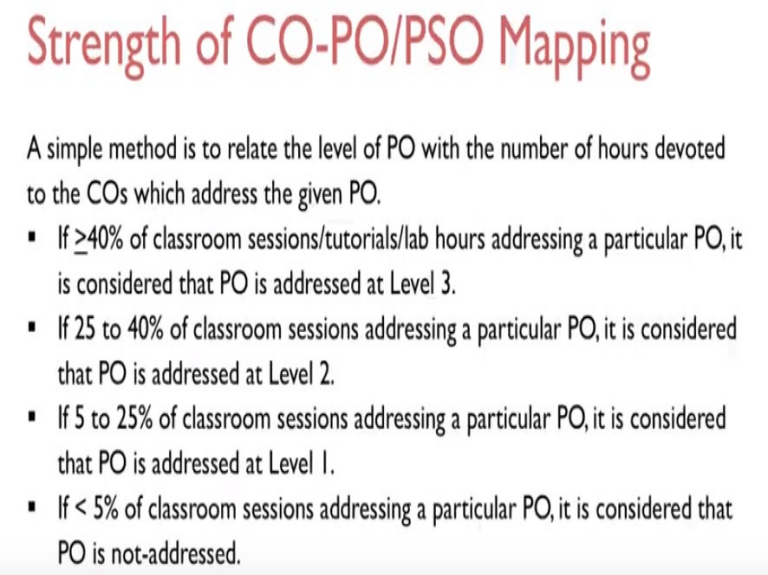

Let us look at one method. One simple method is to relate the level of PO with the number of hours devoted to the COs which address the given PO. That is one of the reasons why we requested when you write a CO you associate the approximate number of classroom sessions you are going to take. One thing you should remember these processes are not exact. You cannot convert them into a short formula. Everything will have to be approximate.

But once you follow one process over years and across all departments, the purpose of computing PO attainment will be served which we will explore later. For example, we said if more than 40% of classroom sessions, tutorials or lab hours addressing a particular PO, we consider that PO is addressed at the level 3. For example 40% is again something like a mutual consent but you can make it 50%, you can make it 60% as well.

And if 25 to 40% of classroom sessions address a particular PO it is considered PO is addressed at the level of 2. Then 5 to 25% of classroom sessions are address a particular PO then we consider that PO is addressed at level 1. Anything less than 5% of classroom sessions, we say you cannot even say it is 1. So we consider that PO is not considered addressed. So this particular what do you call definition of mapping strength becomes the basis for all computations subsequently proposed in computing the PO/PSO attainment.

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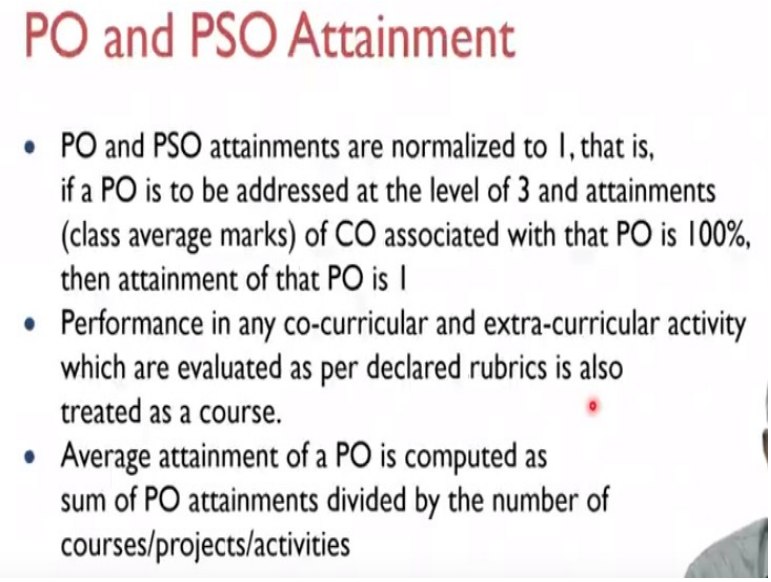

Once again, because there are several like 1, 2, 3 we are mapping, so we need to finally normalize something. So here PO/PSO attainments are normalized to 1. They can also be normalized to any other number. It can be 10, it can be 3, 5 anything that you can do. But PO and PSO attainments are normalized to 1 something that everyone can relate readily. That is if a PO is to be addressed at the level of 3 that means mapping strength is 3. And attainments generally we are using class average marks as the attainment of a CO associated with that PO is 100% then the attainment of PO is 1.

That is the, our normalizing process. So anything in a given class obviously it will be less than 1. But it can be as close as to 1 depending on the quality of your students, the way you are conducting the program and so on. So there are 2 elements. One is the class average marks associated with a CO and the strength of mapping.

They will determine the PO attainment. And here performance of any co-curricular and extra-curricular activities if they are evaluated as per some declared rubrics, rubrics declared in advance to the students can also be treated as a course. For example one can consider any activity as a course of 1 credit over a semester if there are something like 30 hours of activity are involved or students are involved in 30 hours of activity over a semester, I can consider equivalent to 1 credit course.

But here we are not trying to compare co-curricular and extra-curricular activities with the courses as of now. And what we do is we list all the courses, core courses, projects, extra-curricular activities, presentations everything we list and compute the attainment of POs associated with each activity and then take average but when we compute average we take the total number of courses, projects and activities.

So what may happen, a particular PO that is not addressed by many activities and when I divide it by the total number, so obviously that attainment becomes much smaller which may give an uncomfortable feeling to the department.

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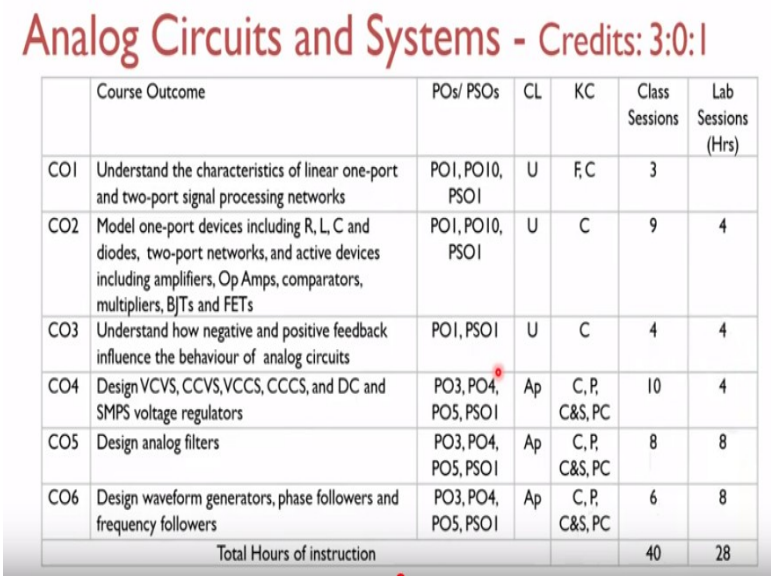

Analog Circuits and Systems - Credits: 3:0:1

	Course Outcome	POs/ PSOs	CL	KC	Class Sessions	Lab Sessions (Hrs)
CO1	Understand the characteristics of linear one-port and two-port signal processing networks	PO1, PO10, PSO1	U	F, C	3	
CO2	Model one-port devices including R, L, C and diodes, two-port networks, and active devices including amplifiers, Op Amps, comparators, multipliers, BJTs and FETs	PO1, PO10, PSO1	U	C	9	4
CO3	Understand how negative and positive feedback influence the behaviour of analog circuits	PO1, PSO1	U	C	4	4
CO4	Design VCVS, CCVS, VCCS, CCCS, and DC and SMPS voltage regulators	PO3, PO4, PO5, PSO1	Ap	C, P, C&S, PC	10	4
CO5	Design analog filters	PO3, PO4, PO5, PSO1	Ap	C, P, C&S, PC	8	8
CO6	Design waveform generators, phase followers and frequency followers	PO3, PO4, PO5, PSO1	Ap	C, P, C&S, PC	6	8
	Total Hours of instruction				40	28

So that need not be worried. That need not be reason for worry. We will explain that. It is not the absolute values that matter but it is the relative values from 1 year to the other that is what matters in as far as NBA accreditation process is concerned. Now to compute all these we take a sample course, Analog Circuits and Systems, credits are 3 classroom hours and 1 laboratory session per week. And there are 6 COs and this is how we have written.

The POs and PSOs are addressed here. As you can see you have PO1 and you have PO10, PO3, PO4 and so on and PSO1. Generally a course is associated with most of the times a course any course if you take it will be associated with one PSO1 if you write your PSOs hopefully what we consider the right manner, okay? And number of class sessions and lab sessions are here and then cognitive levels and knowledge categories are presented here.

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CO Attainment and POs/PSOs

Not every CO_i of a course can address every PO or PSO addressed by the course

CO	POs	CO Attainment (%ge)
CO1	PO1, PO10, PSO1	62.3
CO2	PO2, PO10, PSO1	67.8
CO3	PO1, PSO1	66.9
CO4	PO3, PO4, PO5, PSO1	67.1
CO5	PO3, PO4, PO5, PSO1	61.4
CO6	PO3, PO4, PO5, PSO1	66.2

And now if you look at the same thing that can be can be shown here. CO1 is associated with PO1, PO10 and PSO1 and the CO attainment that particular CO attainment is 62.3% or you can call it 0.623, okay if it is not percentage. So like that with respect to every CO we associated/ associate with the corresponding POs and the attainment of CO.

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Course – PO/PSO Mapping Strength

11 of 68 (16%) sessions are devoted to PO1	Mapping strength is 1
13 of 68 (19%) sessions are devoted to PO2	Mapping strength is 1
47 of 68 (69%) sessions are devoted to PO3	Mapping strength is 3
44 of 68 (64%) sessions are devoted to PO4	Mapping strength is 3
44 of 68 (64%) sessions are devoted to PO5	Mapping strength is 3
16 of 68 (23%) sessions are devoted to P10	Mapping strength is 1
68 of 68 (100%) Sessions are devoted to PSO1	Mapping strength is 3

Now what we do, we now count all the number of hours. There are 40 hours of classroom interaction and 28 hours of laboratory. Out of that 11 out of 68 that is 16% of the sessions are devoted to PO1 and as per our suggested thing mapping strength becomes 1, okay? It is less than 25%. But it is more than 5% so it becomes 1. And whereas with respect to PO2, 13 out of 68 that is 19% so the mapping strength is also 1 for PO2.

For PO3, 47 out of 68 that is 69% through mapping strength is 3. And for PO4 the mapping strength is 3 and for PO5 also it is strength is 3. And the PO10 which is related to communication and it constitutes 23% which is still less than 25%, the mapping strength is 1. And whereas PSO1 is associated with all the COs to that extent it is also mapping strength is 3.

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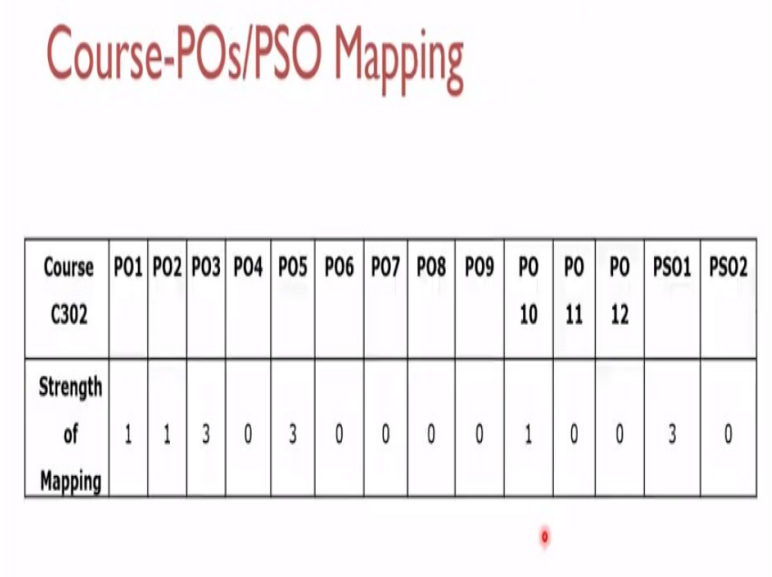

This is what is captured like this. You list all the POs and the PSO, there are 2 PSOs in this and the strength of mapping for this course you list as 1, 1, 3, 0 and so on. So as you can see some of the POs are not addressed by this course. There is nothing wrong with that but we capture like this for all the courses. So this is course PO/PSO mapping.

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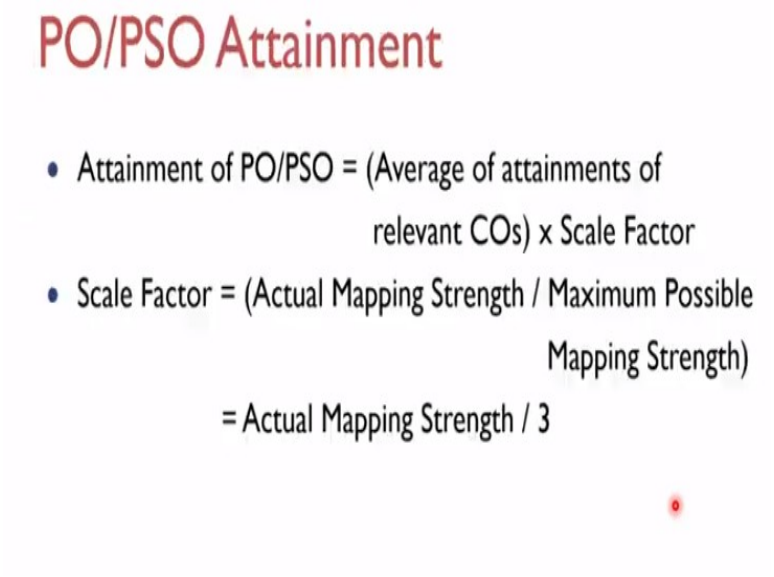

Now how do we compute the PO/PSO attainment? Attainment of a PO/PSO you take average of attainment of relevant COs. For example there are 3 COs that address let us say PO3. So we look at the attainment of those 3 COs and take an average and multiply it by the, a scale factor. What is a scale factor? The actual mapping strength of that particular PO and the maximum possible mapping strength which is always 3 in our case.

So the actual mapping strength divided by 3 is the scale factor. And this is how you compute the attainment of PO.

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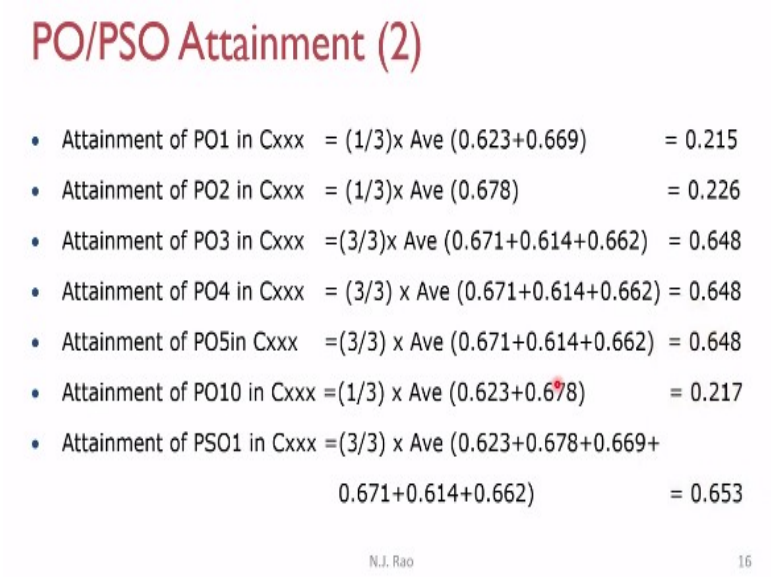

Now attainment of PO1 in this course is 1/3 into average of there are 2 COs that are associated. So average of 0.623+0.669 and that gives you 0.215, okay? That is how we compute the attainment of PO1. You do the same calculation for all and this is how we get our the last column represents the attainment of POs. Because if you look at PO3 and PO4 where the lab sessions are involved actually.

So what happens, the mapping strength being 3 though the average class marks are roughly the same but the PO that particular PO attainment turns out to be quite high because of its mapping strength. Whereas in the others, the mapping strength is much lower. That is the reason why this will also kind of come down.

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Strength and Attainment of PO/PSO

Course C302	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Strength	1	1	3	3	3	0	0	0	0	1	0	0	3	0
Attain-ment	0.22	0.23	0.65	0.65	0.65	0	0	0	0	0.22	0	0	0.65	0

Now we produce it together like this. Each course is characterized by mapping strength as well as actual attainment of the POs and PSOs in this. You can show up to maximum 2 decimal places that is more than enough really.

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Attainment of POs and PSOs

Repeat this computation with every core course, seminar, project, and other academic activities relevant to the attainment of POs / PSOs
So we get a matrix such as the following:

Course	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C101	0.22	0.33	0.85	0.25	0.15	0	0	0	0	0.13	0	0	0.76	0
.....														
C302	0.25	0.22	0.65	0.65	0.65	0	0	0	0	0.27	0	0	0.65	0
.....														
C806 (Project)	0.86	0.82	0.94	0.74	0.84	0.67	0.61	0.21	0.31	0.77	0.82	0.84	0.85	0.79

Now what we do? We combine, we do this for every what do you call core activity and call it course or project. We label them with corresponding value. And then record the attainments in this form. So when you have like this, you may have something like 30 to 35 rows representing all the core activities. So you have to take the average over across all the rows for each column.

Then by looking actually at this matrix we will also know where we are generally our present way of conducting the program if it is not satisfactory with respect to some of the POs that becomes an indication that we need to do something about that.

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Attainment of POs and PSOs (2)

- Determine the Indirect Attainment based on all the relevant Surveys. (Graduate Exit Survey, Alumni Survey, Employer Survey)
- Combine them using suitable weights (typical 0.8 and 0.2)

Now we also do or determine the indirect attainment based on all relevant surveys that is what we showed is the direct attainment and now we also it is necessary under NBA accreditation process to determine the indirect attainment through relevant surveys. These surveys will include graduate exit survey, alumni survey, employer survey and so on. Some of them could be difficult but we have to set the processes in place to get some data from the employers and the alumni.

And we combine them using some weights, typically 80% and 20%, 20% to surveys and 80% to direct attainment. And once we combine the two then we get the actual attainments.

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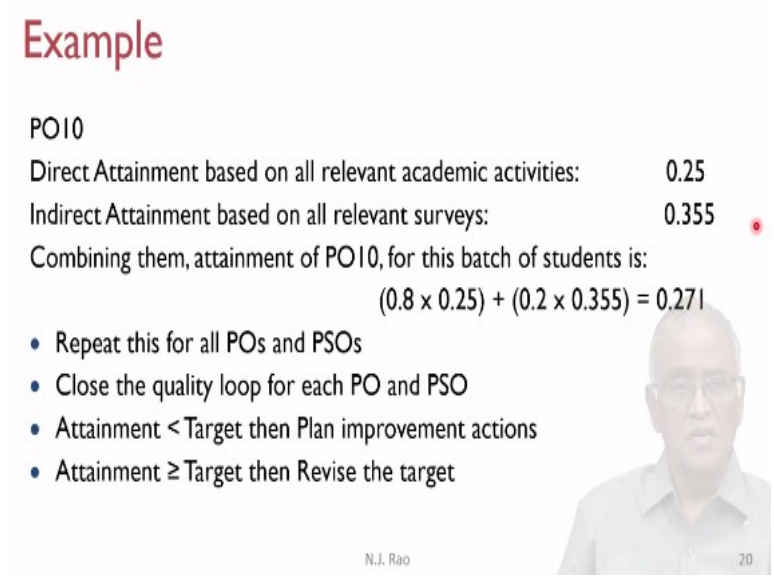

Now let us look at a sample instead of a giving a very complex table. Let us take PO10. Direct attainment based on all relevant academic activities we saw it is 0.25. Indirect attainment based on all relevant surveys, maybe you have done 3-4 surveys and based on that is 0.355. Combining them it by 80, 20% we get 0.271. That is our actual attainment. You repeat this for all POs and PSOs.

Close the quality loop for each PO, PSO by if the attainment is less than target, then plan improvement actions. You have to plan some activities that will improve. Or otherwise revise the target if it has exceeded the target.

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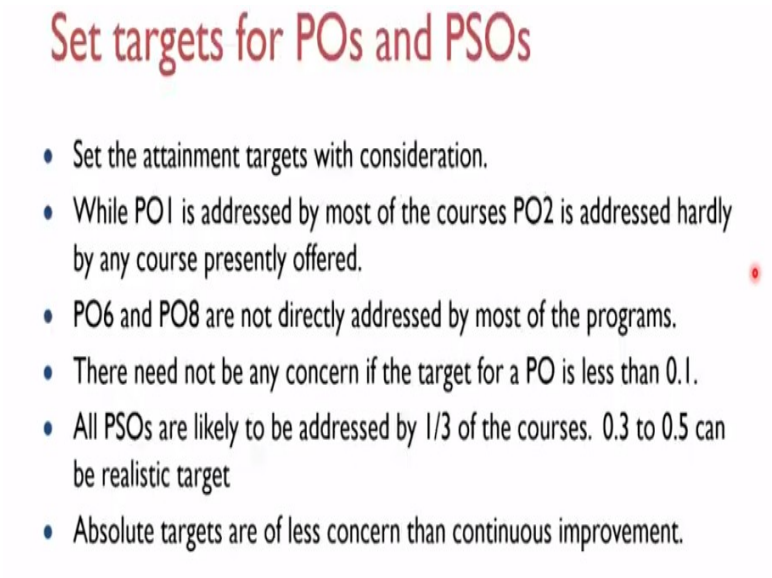

Now when you set the attainment targets, they should be done with consideration. One should not feel bad if let us say I set my target for a particular PO like for example PO6, I may say I can only attain with my current program something like 0.05. It looks like a small number but does not matter. But make it realistic. Otherwise trying to make it let us say 0.6, 0.7 will be very unrealistic. For example PO1 is addressed by most of the courses.

PO2 is as they are offered now, as courses are offered now, is hardly addressed by any course. PO6 and PO8 are not directly addressed by most of the programs. So there need not be any concern if the target of a PO is less than 0.1. And coming to PSOs if you write your PSOs let us say something like 2 to 4 any course will come only under 1 PSO; generally if you write based on the streams that every program has, though one can mix those, but by and large, all PSOs are likely be addressed by one-third of the courses, not more than that.

To that extent 0.3 to 0.5 can be a realistic target for a PO. But because we are finally dividing the PO attainments or PSO attainments by the total number of courses so 0.3 to 0.5 is a quite a realistic target. And one thing again should be remembered that absolute targets are of less concern than continuous improvement.

For example, I may have the present year, I have attained 0.05 and next year I have improved it to 0.06. That is continuous improvement. Whether it is 0.5 or 0.05 strictly does not matter. What

is important is continuous improvement. So please do not focus on or making these absolute values large. Somehow it makes the whole thing is what do you call unrealistic.

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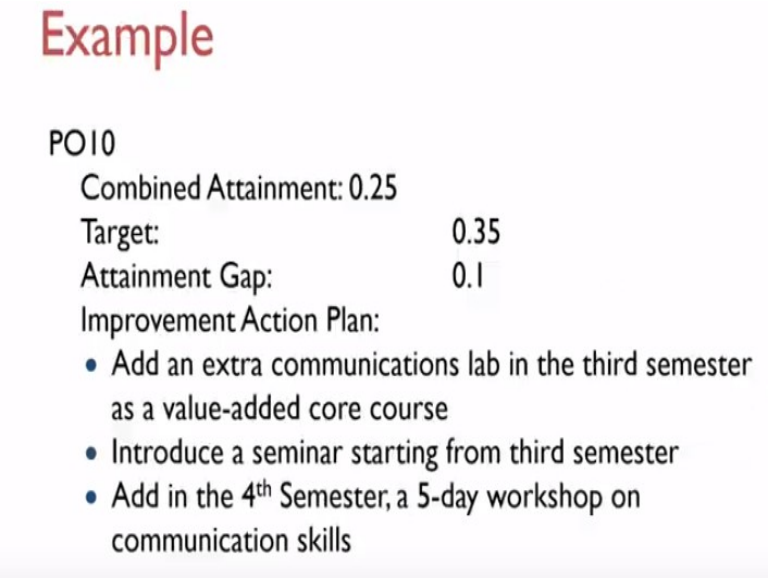

Let us look at an example. Consider the PO10 which is addressed by the course, sample course. The combined attainment is 0.25. Target is 0.35. The attainment gap is 0.1. And to close this gap next year/next time we offer this course, we are going to the proposed plan is this. We had an extra communications lab in the third semester as a value added core course or introduce a seminar starting from the third semester.

Add in the fourth semester a 5-day workshop on communication skills. That is how the specific action plans that you have will differ from teacher to teacher from program to program.

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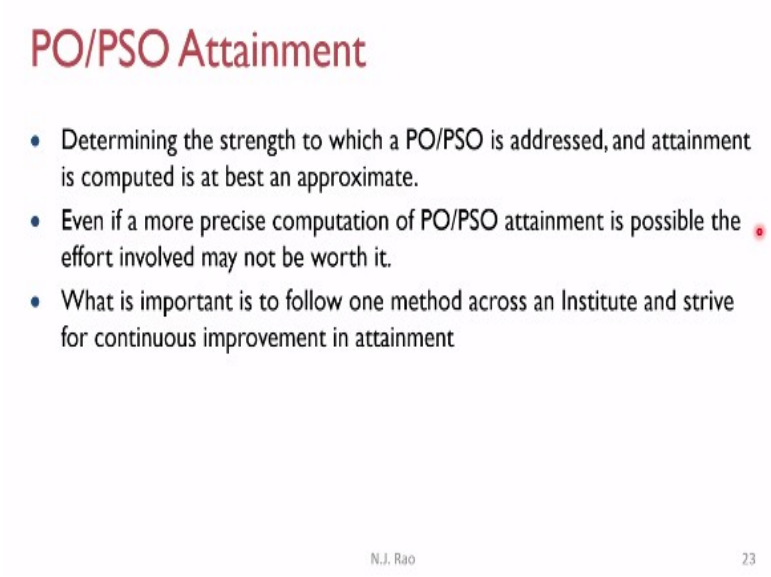

Again, we are repeating. Determine the strength to which a PO or PSO is addressed and attainment is computed is at best is an approximate. It is never, it can never be an exact value. For example I can always define you can always define more complex way of computing the PO attainment which is certainly can be justified.

But the only thing is when you make it more precise, more complicated you should see whether the, it is the effort involved in computing across few hundred courses in an institution is it worth it or not. So what is important to follow is, what is important is to follow one method across an institute and strive for continuous improvement in attainment, okay?

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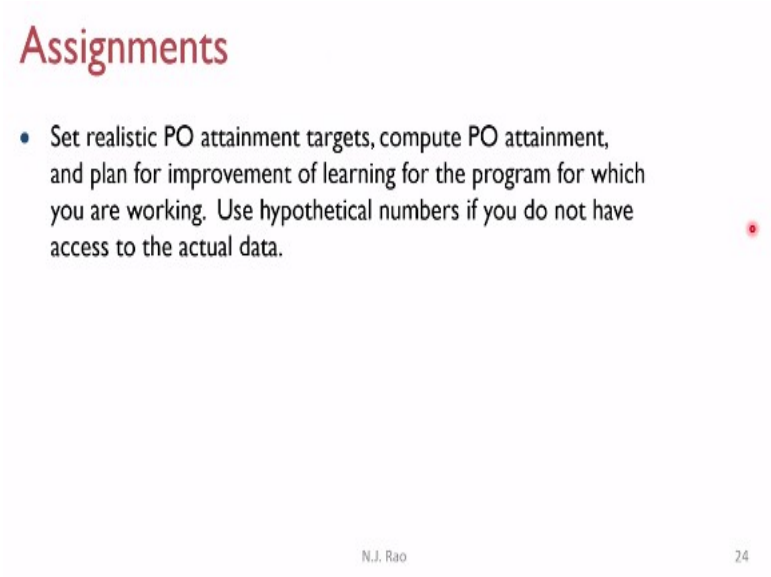

Coming to assignments, set realistic PO attainment targets;. Compute PO attainment and plan for improvement of learning for the program for which you are working. If you are a Mechanical Engineering teacher you look at a Mechanical Engineering program as such. And as far as assignment is concerned use hypothetical but realistic numbers; if you do not have access to the actual data. But initially you may not have access to actual data but as you go along you will have access to the actual data.

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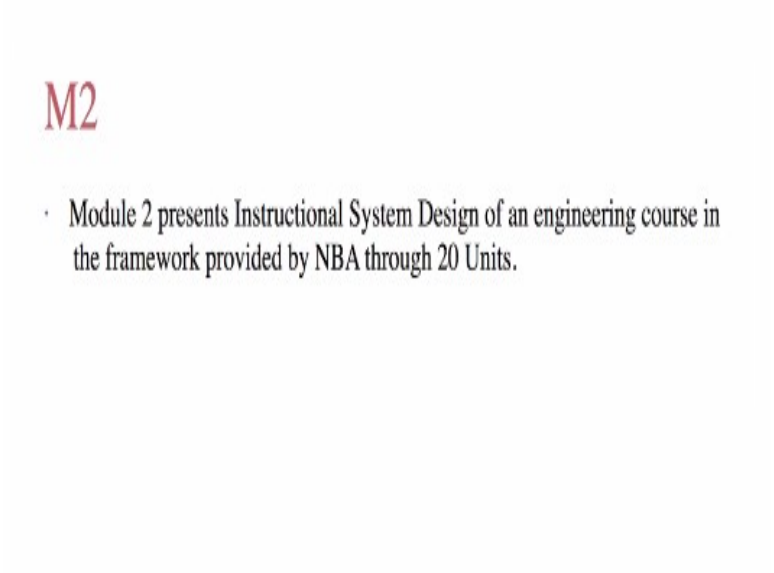

This is the end of the Module 1. Module 2 presents through 20 units of Instructional System Design of an engineering course in the framework provided by NBA. So if you want to design and offer a course, how do you do it effectively within the framework given by NBA, that will be our goal for, that is the aim of Module 2 which will be a completely independent module than this. Thank you very much for attention and I welcome you again to the Module 2. Thank you.