NBA Accreditation and
Teaching – Learning in Engineering
(NATE)
Professor K. Rajanikanth
Retired Principal, MSRIT
Indian Institute of Science, Bengaluru
Lecture 17
Course Outcomes- 1

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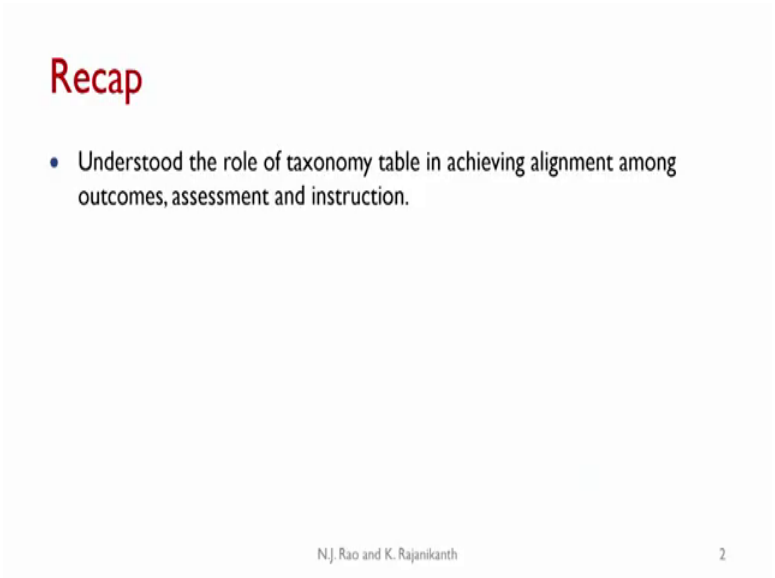

Greetings, welcome to module 1, unit 16 on Course Outcomes. In the earlier unit, we understood the role of taxonomy table in achieving alignment among outcomes, assessment and instruction, the 3 key components of a course.

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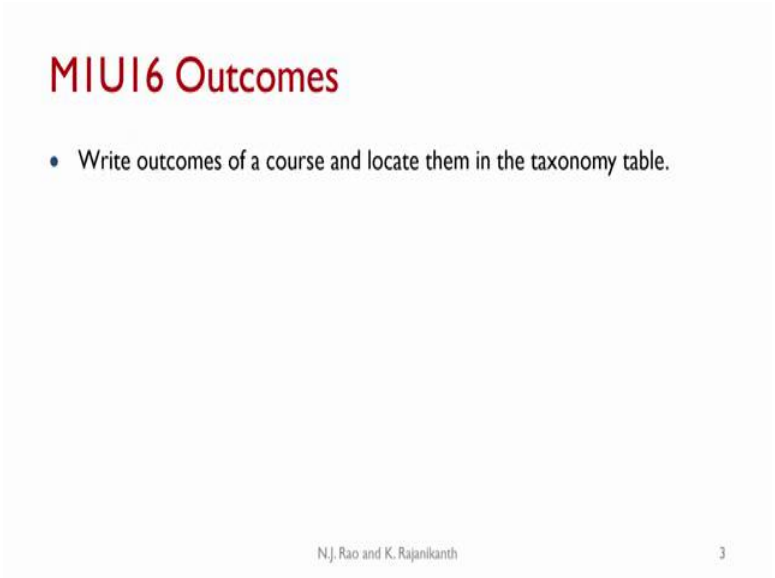

In this unit, we look at how to write outcomes for a course, which are of good quality. So the outcome for this unit is right outcomes of a course, and look at them in the taxonomy table.

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Graduates of Engineering Programs in India are required to attain the program outcomes and program specific outcomes. The 12 program outcomes are specified by the National Board of Accreditation. Two to four programs specific outcomes are identified by the university or the department offering the program. Students are supposed to attain all the 12 program outcomes specified by NBA and the additional 2 to 4 programs specific outcomes identified by the university or the board of studies.

POs and PSOs are attained through courses, projects, co-curricular and extra-curricular activities in which the performance of the student is evaluated. Though all these activities are available predominantly POs and PSOs are attained through core courses.

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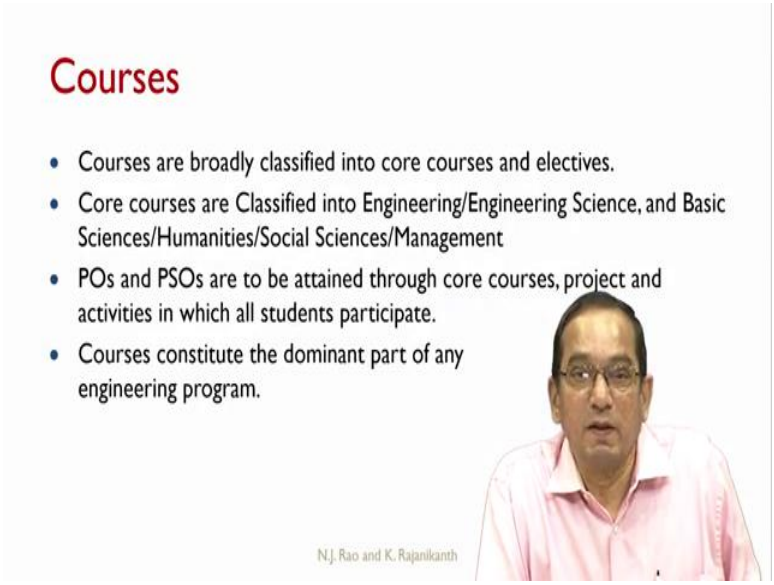

Courses are broadly classified into core courses and electives. And core courses are classified into engineering courses, engineering science courses, basic sciences, humanities, social sciences, management courses. And POs and PSOs are to be attained through core courses, project and activities in which all students participate. Electives do contribute to POs and PSOs, but NBA requires the demonstration of the attainment of POs and PSOs only through core activities.

And thus we have to look at the attainment of POs and PSOs through core courses, project and activities in which all students participate. Among these core courses constitute the dominant part of any engineering program.

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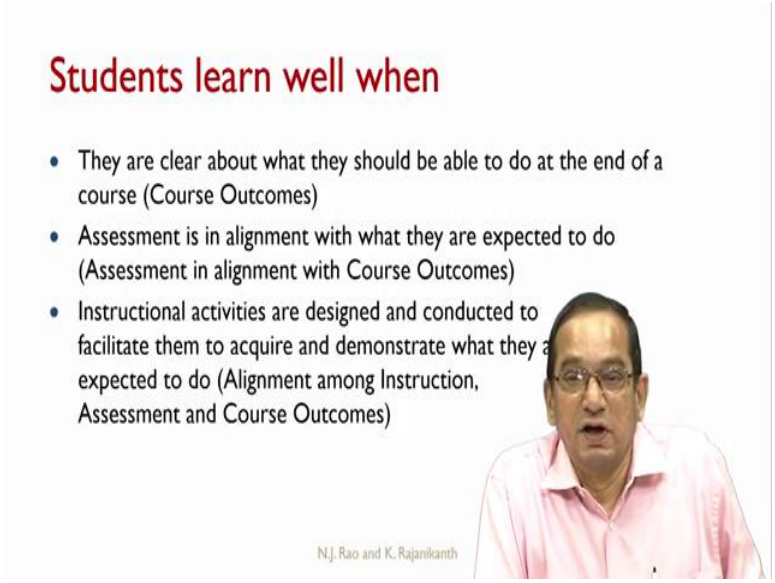

And it is empirically well established that students learn well, when they are clear about what they should be able to do at the end of the course, what we are calling as course outcomes Assessment is in alignment with what they are expected to do. In other words, assessment is in alignment with course outcomes. Instructional activities are designed and conducted to facilitate the students to acquire and demonstrate what they are expected to do.

In other words, we expect alignment among instruction, assessment and course outcomes. When these conditions are met, the likelihood for the students to learn well dramatically increases.

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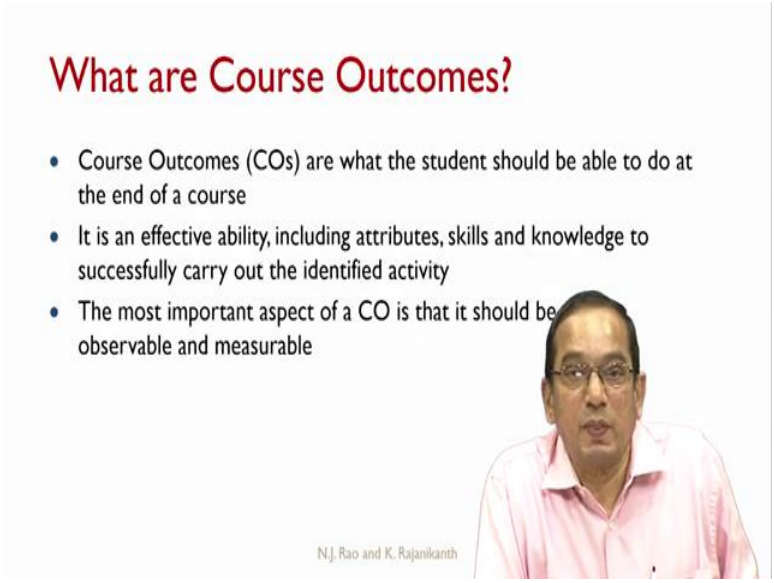

What are Course Outcomes? We have seen in earlier unit also and recapitulating what we have discussed earlier. . Course outcomes are what the student should be able to do at the end of a course. It is an effective ability, including attributes, skills and knowledge to successfully carry out the identified activity. The activity is identified, it is stated in the formal force outcome and it is the effective ability including attributes skills and knowledge to successfully carry out that identified activity.

For a CO, there are two extremely important features, it should be observable and it should be measurable, we can say these are the two extremely important characteristics that a good CO should have. It should be observable and it should be measurable.

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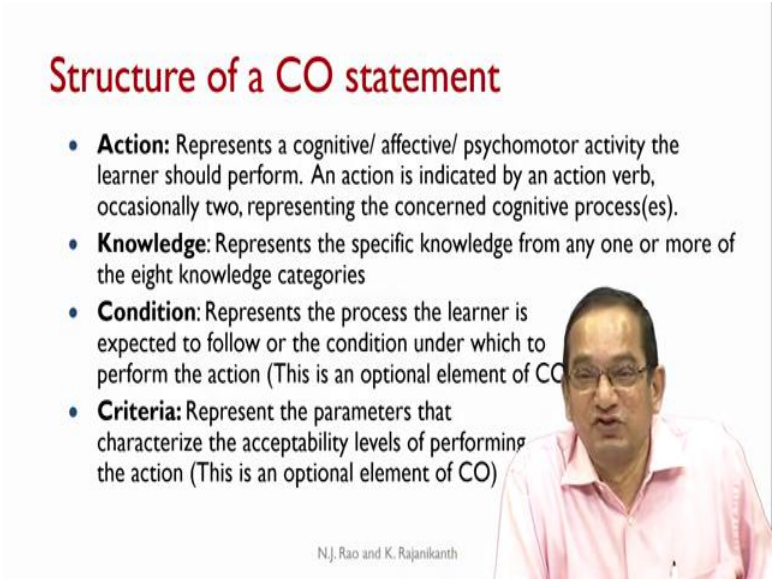

We propose the following structure for a CO statement. It is picked up from different systems which have been proposed over a period of time. And there is no unique way specified by the National Board of Accreditation. But we find that this structure is extremely convenient to develop a outcome statement of good quality. There are 4 fields, action, knowledge, condition and criteria. Among these 4, the first 2 are mandatory. Every CO statement must have an action path and a knowledge path.

The other two condition and criteria are optional. Both may be present, both may be absent, one of them may be present and other may be absent, they are purely optional fields. The first field action, which is mandatory represents a cognitive, effective or psycho motor activity, the level should perform. The action is indicated by an action verb. Occasionally, two action verbs are also used. And these action verbs represent the cognitive process or processes concerned.

So, the CO statement starts with an action verb. This action verb represents the underlying cognitive process or processes. The next field is knowledge which represents the specific knowledge from any one or more of the 8 knowledge categories that we have seen earlier. The 4 general categories and 4 categories specific to engineering proposed by Vincenti, these two are mandatory fields. Then we have two more fields, condition and criteria which are optional.

Condition represents the process, the learner is expected to follow are the condition under which to perform the action. The activity could be performed in a variety of different ways. If

the outcome statement specifies the condition, then the learner is expected to perform that action using that specific method are under those specific conditions. So, this is an optional element of an outcome statement.

Criteria represent the parameters that characterize the acceptability levels of performing the action. Obviously, it must be a correct action that is not what is implied by the criteria. But additionally, the outcome statement may specify certain performance parameters and they indicate the acceptability levels. If they are presented then they become the criteria. This is also an optional field.

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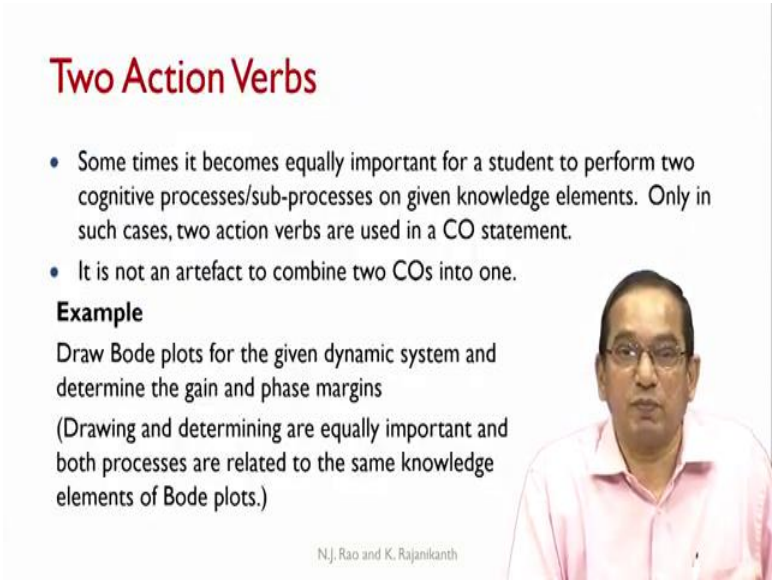

Now, normally a outcome statement must have a single action verb. However, sometimes it becomes equally important for a student to perform two cognitive processes are sub-processes on a given knowledge element. And they are tightly related to each other because they work on the same knowledge element. In such instances, it is okay to use two action verbs. But only in such cases, two action verbs may be used in an outcome statement. It is not an artifact to the combine two distinct COs into one single CO.

If the underlying outcome truly represents two distinct activities on the same knowledge element, we can use two action verbs. An example for that can be draw Bode plots for the given dynamic system and determine the gain and phase margins. Both of these are important activities.

Drawing the Bode plot itself is an apply level activity that is important. Once the Bode plot is available, determining the gain and phase margins is also an important activity again at the

apply level. And both these are related to the same knowledge elements of the Bode plots. Thus in this particular outcome statement, two action verbs are justified.

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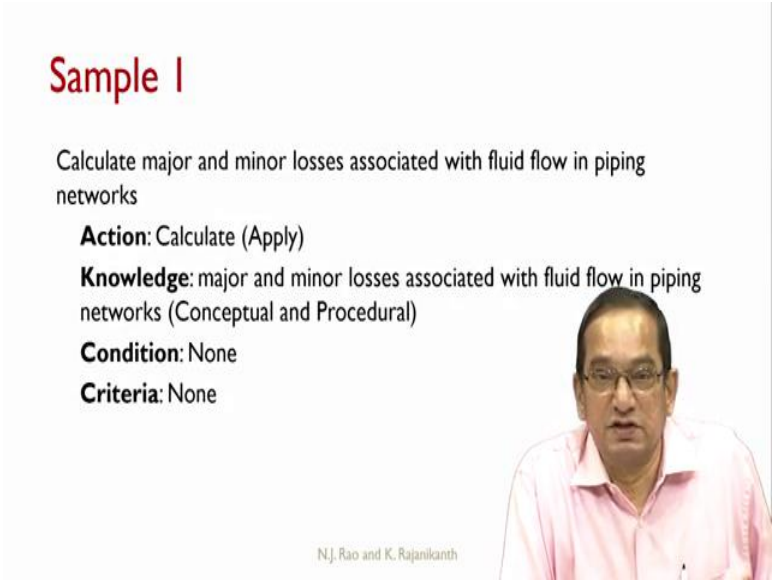

Let us look at some typical outcome statements for sample, calculate major and minor losses associated with fluid flow in piping networks. It starts with the action verb calculate, calculate represents the cognitive process of applied. So, action is calculate and that represents the cognitive process of apply. The knowledge element involved is major and minor losses associated with fluid flow in piping networks. This would be both conceptual knowledge and proceeded knowledge.

Note that the knowledge element need not be belonging to only a single category there can be multiple categories of knowledge elements. The action verb is, either a single action verb or at most a two, but the knowledge elements can be from multiple knowledge categories, there are no conditions and no criteria in this outcome statement, they are optional. And in this outcome statement, we have only the action and knowledge, no conditions, no criteria.

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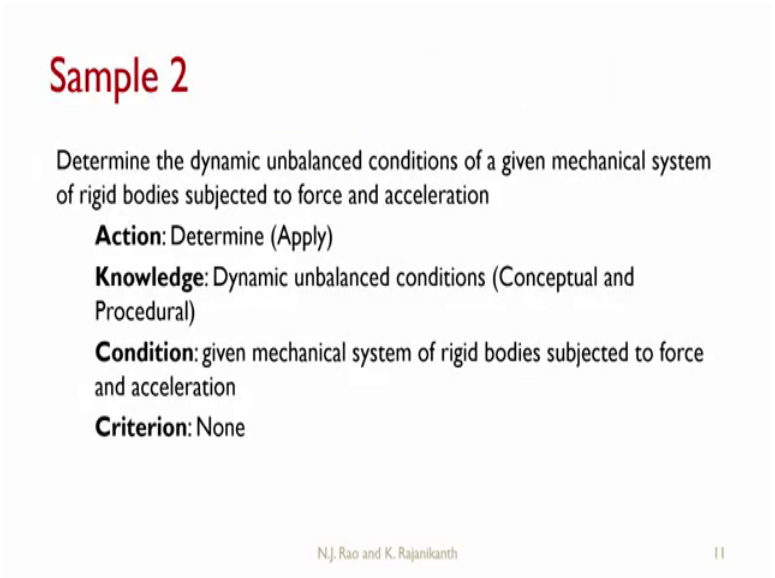

Another sample, determine the dynamic, unbalanced the conditions of a given mechanical system of rigid bodies subjected to force and acceleration. Again notice that this outcome also begins with an action verb determine. So, the action is determined and determine is again at the cognitive level of apply. The knowledge elements are dynamic unbalanced conditions of a given mechanical system of rigid bodies subjected to force and acceleration is there.

So, the knowledge is dynamic unbalanced conditions, conceptual and procedural. The condition is that the mechanical system is the given mechanical system. So, given mechanical system of rigid bodies subjected to force and acceleration, so that specifies a condition. There are no specific criteria mentioned. Obviously, the determination must be correct but beyond that there are no specific criteria mentioned for specifying the acceptability levels of the performance. So, we have action, knowledge and condition but no criteria.

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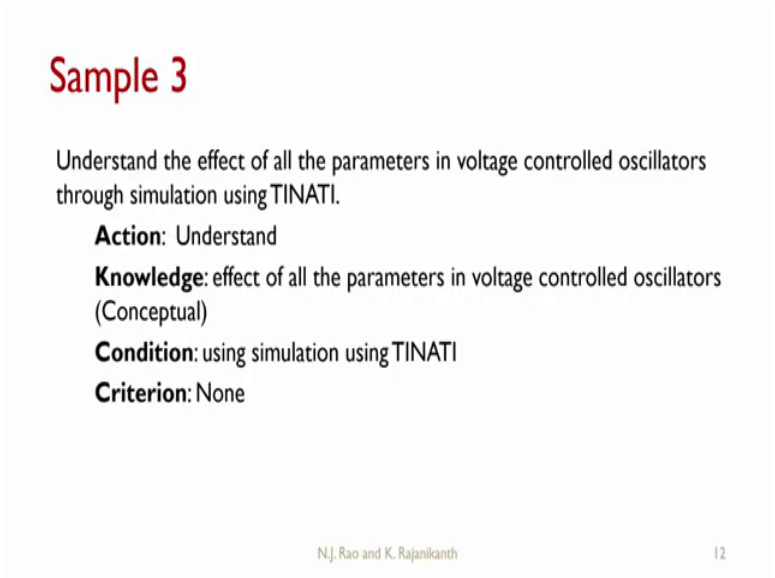

Sample 3, understand the effect of all the parameters in voltage controlled oscillators through simulation using TINATI, again the action is understand. So, now the cognitive level is understand, understand as seven cognitive sub-processes we noted, one could use one of the sub-processes if one prefers to use that specific sub-process. Otherwise one could also use understand, revised bloom taxonomy permits the use of the word understand.

So, the action is at the cognitive level of understand that knowledge is effect of all the parameters in voltage controlled oscillators, basically it is a conceptual knowledge. The condition is using simulation, using a specific tool, TINATI. So, under those conditions, we need to understand the effect of all the parameters in the voltage controlled oscillators. There are no specific criteria.

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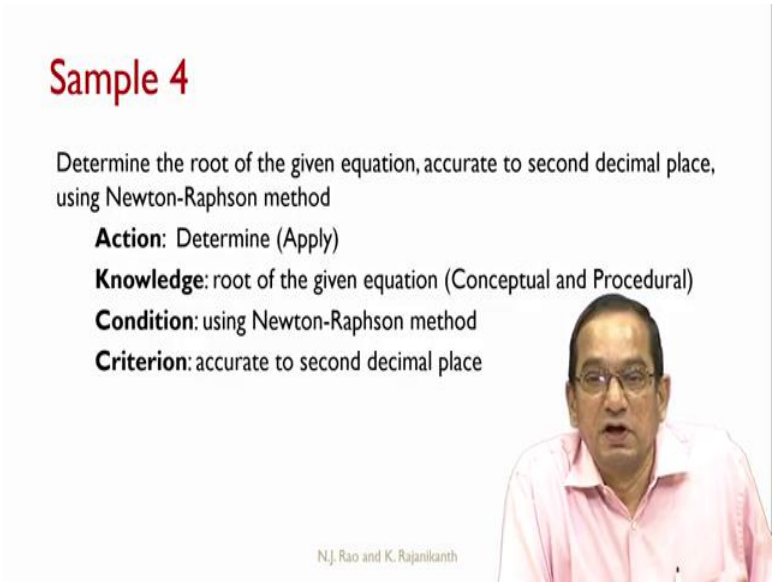

Another sample, determine the root of the given equation, accurate to second decimal place using Newton-Raphson method. So, here the action is determined, which is at the cognitive level of apply. The knowledge is root of the given equation, conceptual and procedural, condition is using Newton-Raphson method. There are several different methods for determining the root of a given equation.

This particular CO states that the learners are supposed to determine the root using Newton-Raphson method, one specific method they are indicating, so there is a condition specified. Further, it also specifies a criterion, the computed root must be accurate to second decimal place. So, it is not adequate if the student is able to use Newton-Raphson method. The produced result must be accurate to second decimal place.

So, there is a specific performance criterion mentioned in the outcome statement. So, this statement has all the 4 elements, action, knowledge, condition and criterion.

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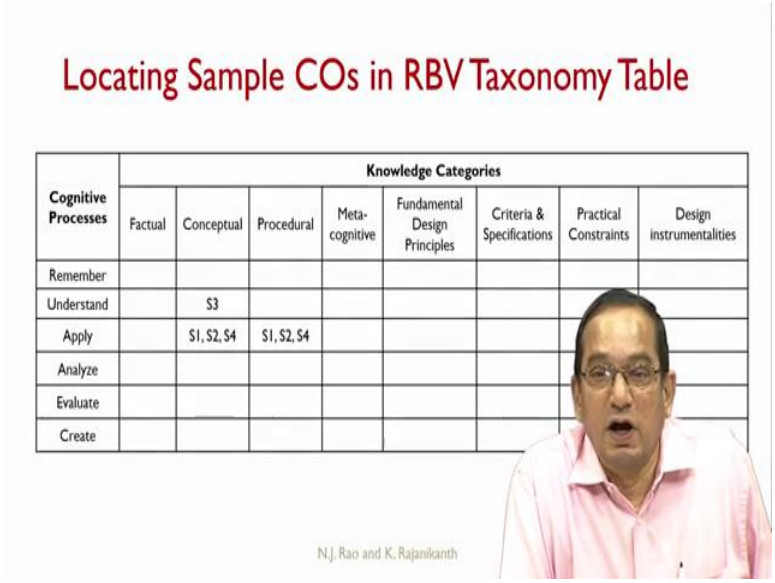

And once we have the outcome statement, we can locate the course outcome statement in the revised bloom Vincenti taxonomy table. If you look at S 1, S 2 and S 4, the samples, 1, 2 and 4, all of them were at apply level. You see the sample 1 is at apply level, sample 2 is also at apply level, sample 4 is also at apply level.

So, when we locate the COs in the taxonomy table. S 1, S 2, S 4, they are all at apply level but S 3 is at understand level, and the knowledge categories involved were conceptual and procedural for S 1, S 2 and S 4, but it was conceptual for S 3. So based on the action, and the knowledge category, we can locate the course outcome in the RBV taxonomy table.

Later, we will see that we can locate the instructional activity as well as the assessment item in the same taxonomy table. And that could help us to determine if the alignment is proper or not among the outcomes in certain activities and assessment items.

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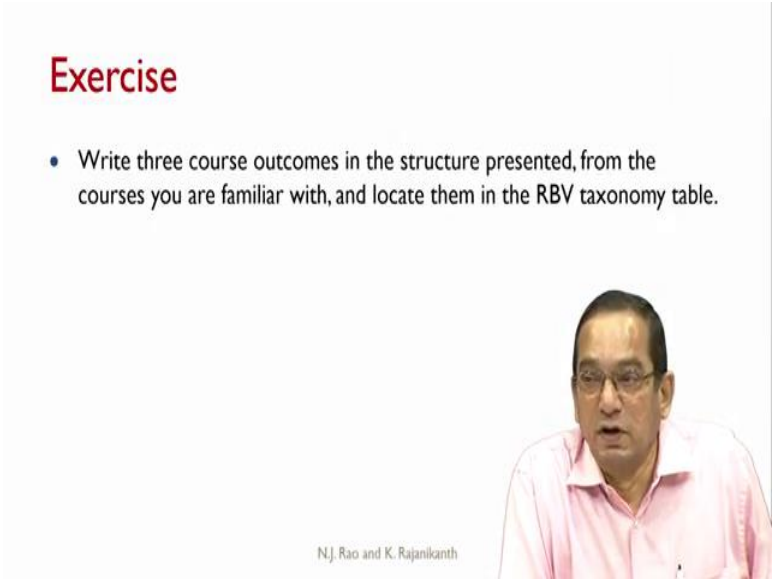

Write three course outcomes in the structure presented from the courses you are familiar with, and look at them in the RBV taxonomy table. Thank you for sharing these results at the mail IDs which we already have indicated.

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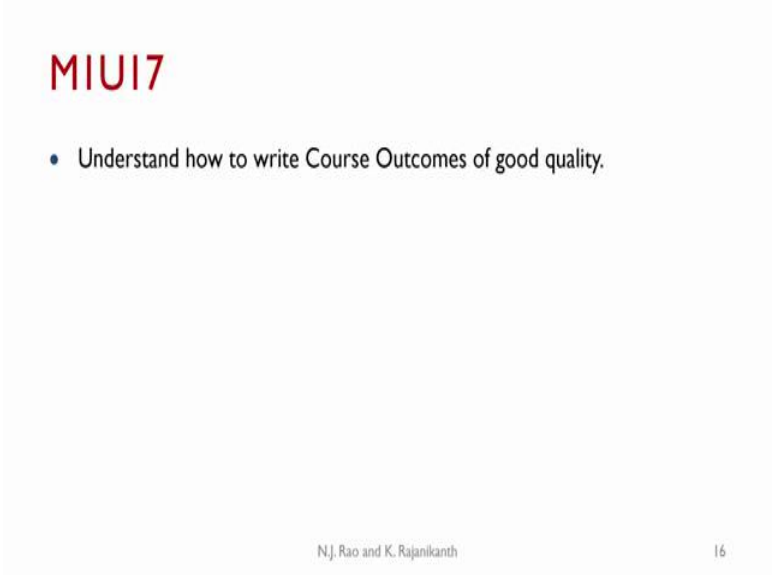

In the next unit, we look at how to write Course Outcomes of good quality further okay. Thank you and we will meet again. Thank you.