TALE - 2 Course Design and Instruction of Engineering Courses
Prof. N. J. Rao
Department of Electronic Systems Engineering
Indian Institute of Science, Bengaluru

Lecture - 04
Analysis Phase 1

Greetings and welcome to TALE Module 2 Unit 4, this is related to the Analysis Phase of the ADDIE.

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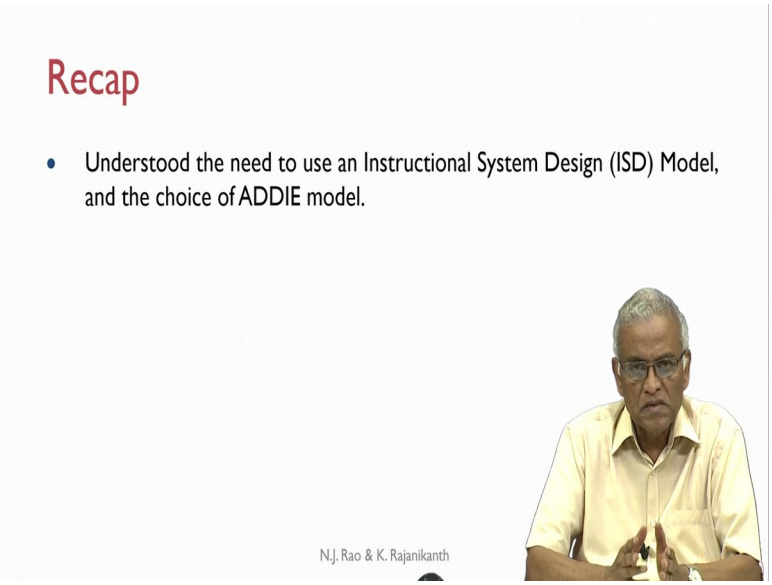

In the previous unit we understood the need to use an Instructional System Design model. To increase the quality of learning it is be said that it is preferable to use an ISD model. Out of several ISD models we chose ADDIE model. ADDIE refers to Analysis, Design, Development, Implement and Evaluate. We also said this model is iterative and it is a systems model; that means, you are going back and forth with a lot of feedbacks. Every element in that is going to influence every other element and so on. So, it should be treated instructional system design model.

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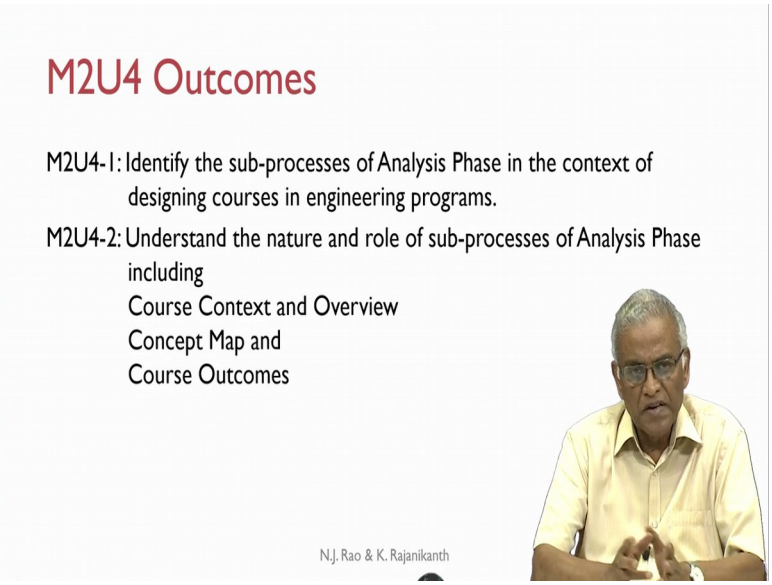

In this unit we will identify the sub-processes of Analysis Phase in the context of designing courses in engineering programs. Also understand the nature and role of sub processes of Analyze Phase, particularly Course Context and Overview; Concept Map and Course Outcomes.

What needs to be understood is that the ADDIE is such a generic model that it can be applied to all types of things, any type of training program, any formal course, any short term course, it could be manual training program or any kind on any subject short term, long term, anything it can be applied.

The language or the elements of each phase, or sub-processes of each phase: we identify (that is where you have the full choice.) the context of designing courses in engineering programs. If it is non-engineering program these sub-processes may differ.

In the context of engineering programs, we are trying to identify the sub-processes. Even these sub-processes that I am presenting are what a group of us felt are the appropriate ones. They are not unique. You can also modify these sub-processes and make the design of the course or the ADDIE version of your course your own. In this unit, you will be looking at three of these sub-processes and the remaining ones we will look at in the in the following unit.

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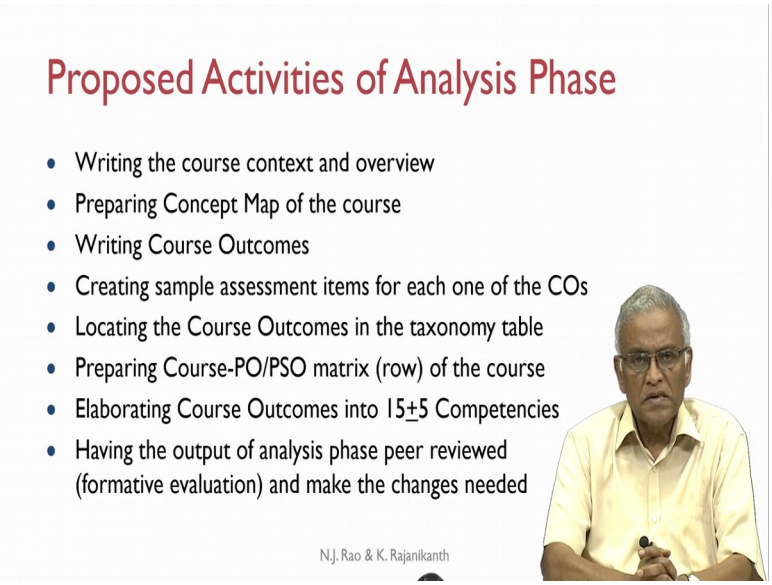

The proposed activities of the analyze phase include writing the course context and overview, and preparing the concept map of the course. Each one of them is a well-defined activity. Writing course outcomes, creating sample assessment items for each one of the CO's, locating course outcomes in the taxonomy table, preparing the CO-PO matrix of the course, and elaborating each course outcome into several competencies are also analyze phase activities. The number of competencies could be 15 plus or minus 5.

Having done all these the output of the analyze phase is peer reviewed. After the peer review you make changes if they are needed These are the activities of proposed analyze phase.

We shall now look at writing the course context and overview; preparing the concept map of the course and writing course outcomes.

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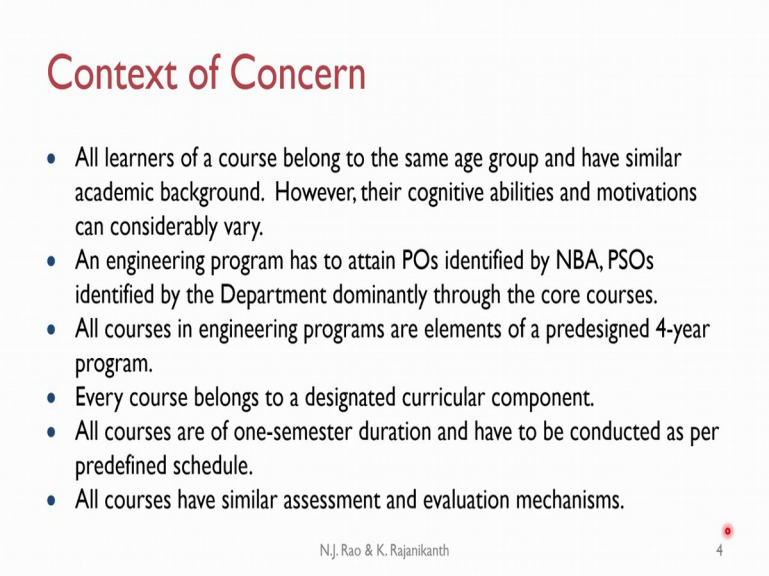

Context of concern: As mentioned earlier, a course is an element of a program, and the program itself has to meet a certain number of outcomes namely program outcomes and program specific outcomes. Further, the course may be a prerequisite to some other course, or a course expects specific prerequisites to be fulfilled by the students. A course can never be seen in isolation, and it is always in a context.

There is also a context for the entire program: what kind of students come, what kind of curricular component does it belong to and so on. Let us look at what is the context of concern for any course. First of all, learners of a course belong to the same age group and have similar academic backgrounds.

However, their cognitive abilities and motivations can considerably vary. For example, in a context, especially in United States of America, the students who come to a course do not necessarily belong to the same age group. They have people who have work for several years in the industry and enter into an engineering program after considerable experience.

A significant number of them could be graduates from the twelfth standard, and you may have working mothers, single fathers, single mothers. In such a case designing and conducting the course will have to be somewhat different.

In the Indian context all learners of a course belong to the same age group, and they have similar academic backgrounds. An engineering program should attain POs identified by NBA and PSOs identified by the department. These should be attained dominantly through core courses. Electives do not come into picture for NBA accreditation processes; not that the electives have nothing to do with POs and PSOs.

All courses in engineering programs are elements of a pre-designed 4-year program; that means, somebody has already designed the curriculum, and there is a sequence of courses, and it is pre-designed. A given course is an element of a program. Every course belongs to a designated curricular component; all courses are of one-semester duration and should be conducted as per the predefined schedule that is also constraint. All courses have a similar assessment and evaluation mechanisms (not identical, but similar.) In some programs (for example primarily related to management; not as part of engineering program) the course may not be of one-semester duration.

The course may happen only in one month in an intensive fashion that will be quite different. Generally, in all engineering programs a course is spread over one semester. It has some characteristics which are desirable, but right now we will take it for granted that every course follows (all courses are of one-semester duration and are conducted as per the predefined schedule) predefined schedule in engineering programs.

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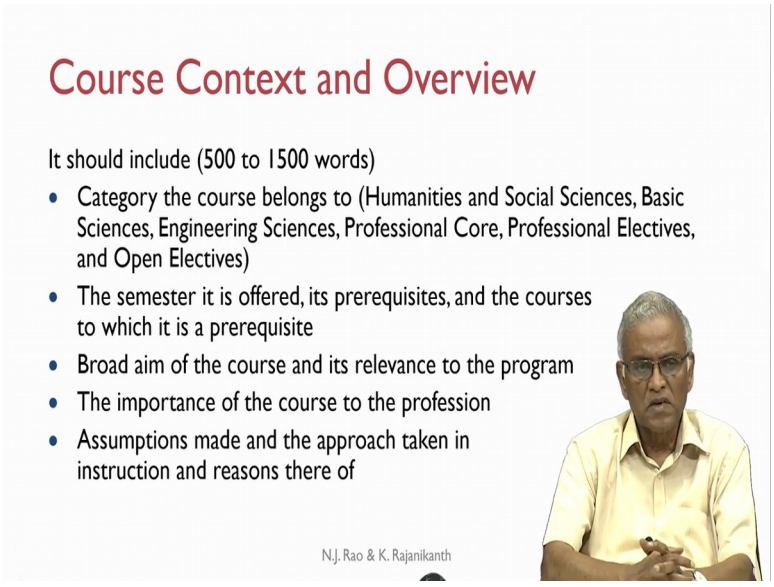

Based on this course context and overview should be written. It should include 500 to 1500 words. In fact, it is good to write as much as you can. The elements of this course context and overview will include the following:

Category the course belongs to: for example, a course can come from humanities and social sciences, basic sciences, engineering sciences, professional core, professional elective or an open elective, it can belong to any of these 7 categories.

The semester it is offered its prerequisites, and the courses to which it is a prerequisite. For example, a course A is offered in the fourth semester, it has the following prerequisites, unless the students take the prerequisite course, they cannot even understand this (course A). Even if they are permitted to do that, they will not be able to do unless they have the prerequisite knowledge.

Many a time this course A is prerequisite to some other course B. Llet us say a fourth semester course can be prerequisite to a 5^{th} semester course or a 6^{th} semester course. One has to understand the sequence that should be written like that point should need to be elaborated through a few sentences to explain the course context.

Write the broad aim of the course and its relevance to the program. Write 2 or 3 sentences saying what is the broad aim of the course? Why am I learning this or what is it that I am learning, learning at the end? (Can I express the course in terms of 1 or 2 sentences.)

Why should it be part of this program, why was it made as a part of this program? It maybe a course in mechanical engineering, why am I learning this course in this branch. So, somebody will have to explain generally, and the curriculum designers should explain that, or the instructor or the teacher who is designing the course can express his view of the relevance of the course to the program.

Broadly if you consider why am I learning this? After I leave the program, when I get my degree (it is required for getting the degree,), is it really of any use to the profession I am likely to join? The importance of the course to the profession, in the words of the teacher, should be explained preferably in a paragraph, where exactly this knowledge is likely to be used. The more the student is convinced of its importance to the profession,

the more motivated he is likely to be. Explaining this will get the attention of the student in the course.

What assumptions I am making in designing this course? Like, what are the things that I consider important or its applications, I should explain in detail, and then the approach that as a teacher I am taking in the instruction, and why am I taking that kind of approach their off.

All these 5 elements should be elaborated into several paragraphs leading to 500 to 1500 words. If one spends a little time, the course context and overview can be nicely explained. It need not give the list of topics at all. That is not part of this course context and overview, and will come at a different place.

When the student read course context and overview, he internalizes why he is doing this course and why is it important to his profession.

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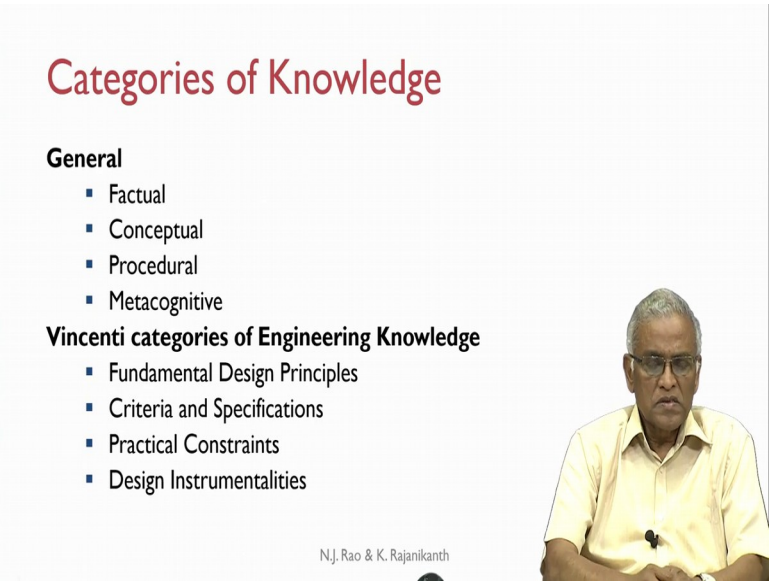

One of the things that we are going to do is to create concept map. Before that we need to be clear that there are categories of knowledge that we have already identified in Module 1. The general categories are Factual, Conceptual, Procedural and Metacognitive; also Vincenti categories of engineering knowledge, Fundamental Design Principles, Criteria and Specifications Practical Constraints, Design Instrumentalities.

A course can be looked from any of these knowledge categories. For example, I can look at it from factual perspective. What are the facts and facts I am going to learn, I organise my course in terms of the facts that I am going to pick up, but normally that is not done.

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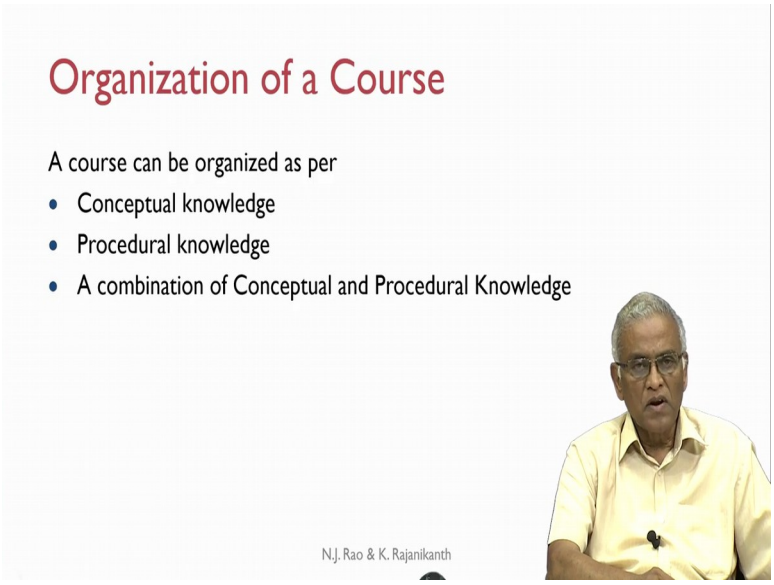

A course can be organized as per conceptual knowledge, or procedural knowledge, or a combination of conceptual and procedural knowledge. In principle it can be done by any of the 3 varieties.

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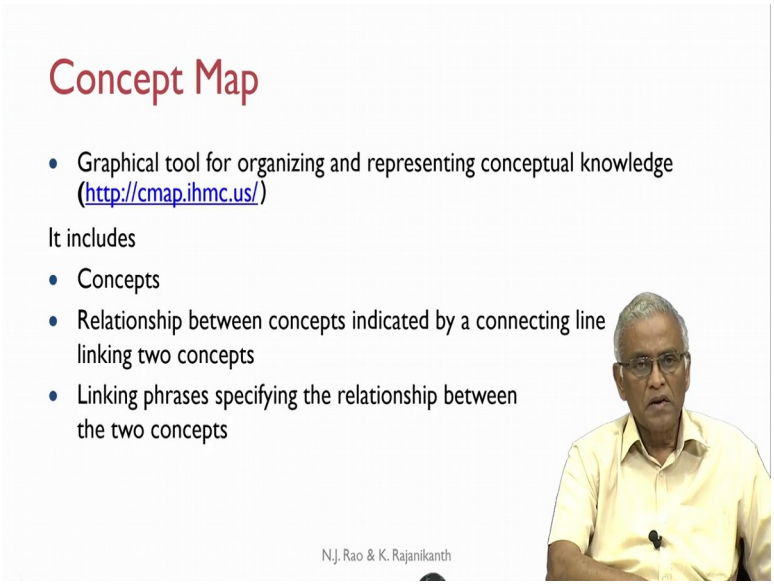

The concept map: is a graphical tool for organising and representing conceptual knowledge; that means, we identify all the concepts that we consider are important in the course; organise them in some hierarchical fashion linking one to the other, and present it graphically.

This tool has been developed more than 25 years ago at the University of Florida; centre called IHMC. It has been developed there, one can visit to that website, and find out more about it. It is still popular, it is still continuously getting evolved, there are lots of features and we will only look at some features relevant to us.

Concept map includes Concepts; the relationship between concepts indicated by connecting line linking backgrounds concepts (we just connect by a line.) Then, write a linking phrase specifying the relationship between the 2 concepts. There are only 3 elements in concept map - we will presently see the example.

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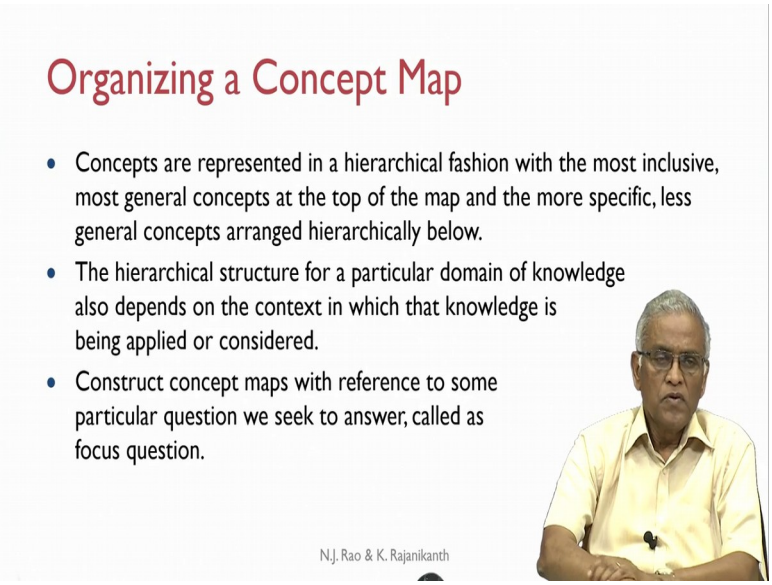

How do we organise the concept map? They are represented in hierarchical fashion with the most inclusive or most general concepts at the top of the map and more specific, less general concepts arranged in hierarchically below. So, a concept map can have several layers, but if you have too many layers it may look a bit intractable, we will find there are some simple artefacts that we can use to look it very elegant and useful.

The hierarchical structure for particular domain knowledge also depends on the context in which that knowledge is being applied or considered. There is nothing like universality about it. What is the most important concept and what is required to fully understand that concept also depends on the context? Generally, it is good to write a question for which we are seeking answer in the course.

We will see from an example: I am teaching a course on digital systems. What is the question I am trying to answer? I am trying to look at designing digital systems of certain kind, and I need to understand how to go about designing that. What kind of digital systems- I will clarify by saying that I am trying to design both combinational and sequential circuits. I may want to further qualify the sequential circuits that I want to design.

By posing a question or what we generally write as broad aim of the course I can draw the concept map. There is plenty of literature available on the internet; one can read that and understand the concept map. In my opinion the concept map is a great tool to create a course.

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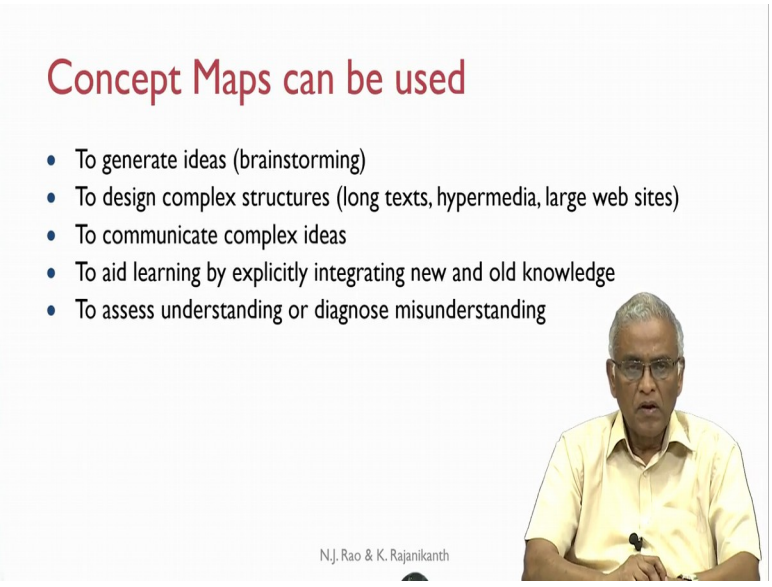

Concept maps can be used to generate ideas like for brainstorming; to design complex structures, long tests, hypermedia, large websites, to communicate complex ideas, to aid learning by explicitly integrating new and old knowledge, and to assess understanding or diagnose misunderstanding.

In fact, by making students to draw a concept map one can find out what are the misunderstandings of the individual. Concept map is a tool to organise the elements of a course There are other types of maps, there is mind map, topic map and so on. The mind map is less structured than concept map, and it has it is own uses.

We are saying that concept map is a little more organised. As it is structured it has own limitations. Topic maps are more structured. We will not worry about the topic maps and mind maps and mainly look at concept maps here.

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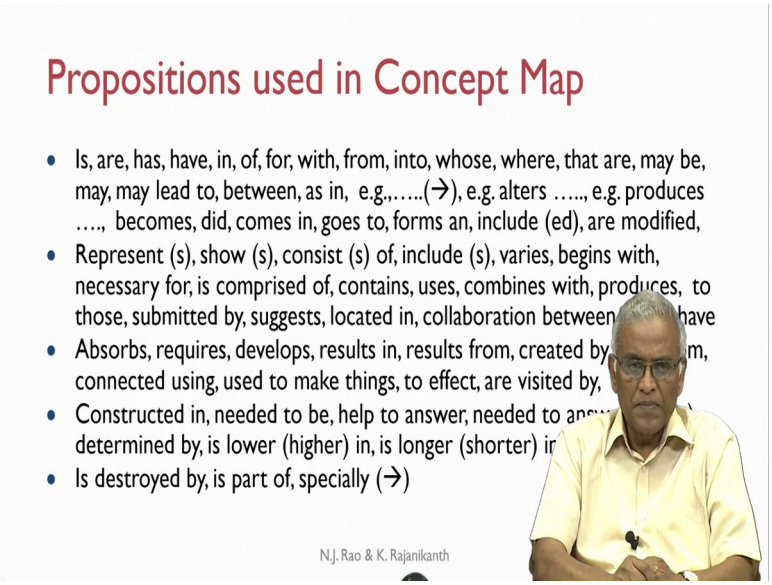

Two concepts in a concept map are connected by a link and with a proposition attached to that link statement. Some sample propositions that we can use include represent, show, consist of, include, and varies. These are not really the action verbs that we talked about in the Module 1 or in writing COs. These are just propositions, that can link two concepts. By looking at examples we will be able to see.

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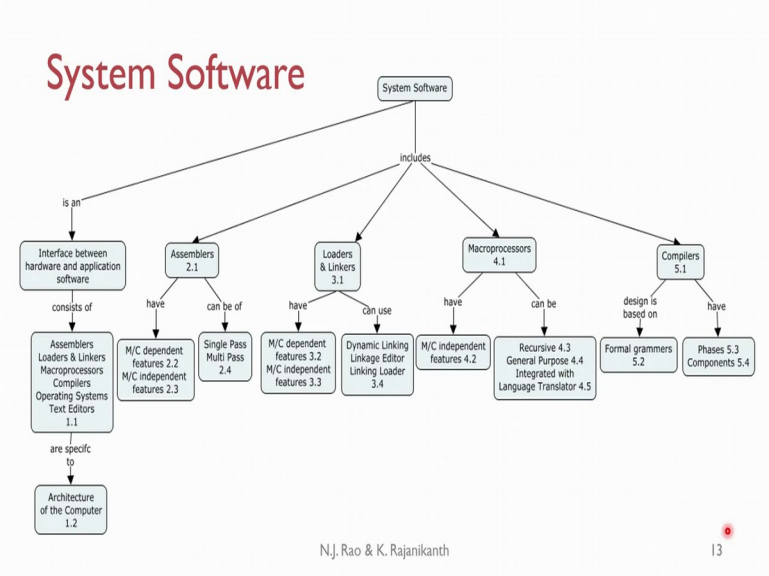

This may not be that very clear to see, but we will give this is a part of the notes. So, you will have a chance to see it in detail. For example, this is a course on System Software. Whatever that is written inside that box is a concept or a list of concepts. You cannot put a procedure inside the box and that is one mistake that is likely to happen when you are working first time with concept maps.

You should make sure whatever you put inside the box is a concept. Here the highest concept is system software. Here we have a proposition is/an. So, when I read this and whatever that is written here it should make sense. For example, the concept says "system software is an interface between hardware and application software." When I go down "interface between hardware and application software" consists of assemblers, loaders, linkers, macro-processors, compilers, operating systems and text editors.

We made a list of about 6 of concepts, these 6 can be shown as 6 different boxes. But, if I start expanding them into 6 different boxes, the map becomes messy and complex. Therefore, I list them in a single box to indicate they are at the same level of hierarchy.

There are 4 levels in this Concept map. Each level is set up in one line. In whatever way you start writing the concept map, in the end you can clean it up to bring it into a structure like this.

System software includes assemblers, and assemblers have machine dependent features and machine independent features. Assemblers can be single pass or multi pass assemblers. Single pass and multi pass are two different concepts, machine dependent features is one concept, and machine independent features is another concept. So, that is how we organize all the concepts.

For example, while operating systems is one of the elements of system software. I am not including operating systems in this course. Operating system is offered as an independent course, or sometimes even “compilers” is are offered as an independent course.

It all depends on what exactly you are trying to handle or what is the scope of the course. And all the related elements will have to be presented in this form. Another feature of this concept map is when you are going from left to right, some inherent or implicit sequence can be there; that means, when I am offering the course, first I will try to present this part and then I come to assemblers. How many lectures do I take comes later, but this is the sequence in which I go.

Left to right also represents the sequence in which we are going to deal with the topic. That is how you prepare the concept map. While creating the concept map, it takes a few hours or maybe a few days for 2 or 3 people to work together to create a satisfactory concept map, but one thing we can assure you it is a very interesting and satisfying exercise, wherever we have done this kind of workshop of drawing the concept map.

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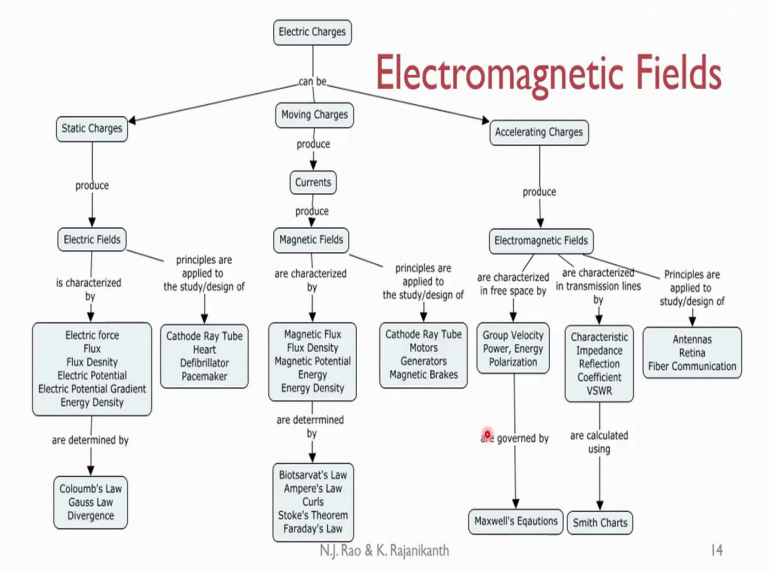

This is a map created by a professor who was teaching Electromagnetic Fields, and this is beautiful way of looking at this subject. “Electric charges” is the core item, and electric charges can be static charges, moving charges, or accelerating charges, and that is how the entire course structure and organised.

The student understands the relationship between all the topics that he is learning. For example, we looked at the static charges and then come to moving charges. Student can relate that how some properties of moving charges differ from static charges. A graphical representation is greatly helpful for the student to organise his knowledge internally; he will be able to relate one to the other very effectively.

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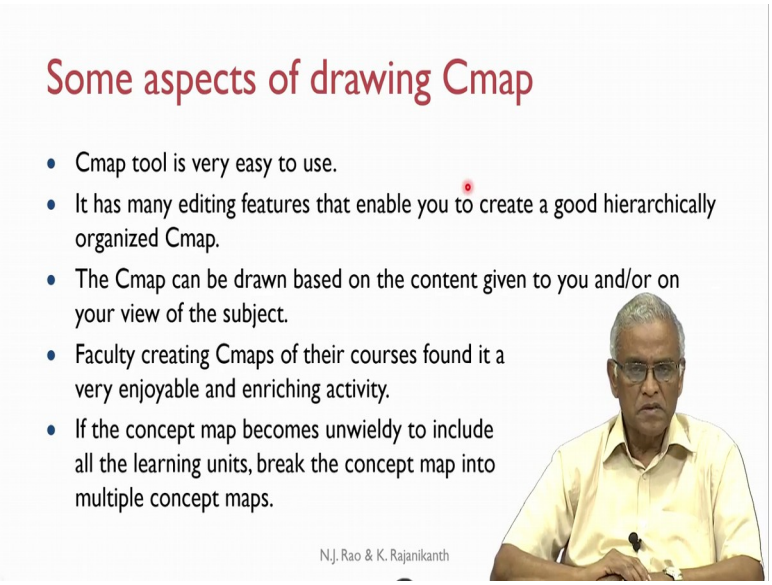

CMap tool is very easy to use software, is designed beautifully and it takes only 5 minutes for you to start drawing the concept map. One need not have to focus on the details of how to handle the program and how to write and so on. It is all graphic, 5 minutes introduction is all that is required, and you can start creating the Cmap and focus on the subject rather than on the tool.

It has many editing features that enable you to create a good hierarchically organised Cmap, you can put colours, you can organise them, you can put lots of things what you think will enhance the quality of the map. The Cmap can be drawn based on the content given to you and or on your view of the subject. For example, the same content given to 2 teachers may lead to 2 slightly different concept maps rather than the identical ones.

The Cmap represents your view of the subject. Faculty creating Cmaps of their courses found it very enjoyable and enriching activity. If, the concept map becomes unwieldy, that there are too many elements or too many layers in that, you can break it into multiple maps and link them one another.

There are mechanisms in this. By linking one map to the one box, by double clicking that other map will open in front. There are wonderful features in the tool, and incidentally this tool is free to download. It is an open source tool, and you can visit the website or you just search Cmap tool; get access to that; download and start working. File size is about 100 MB, which takes some time for it to download.

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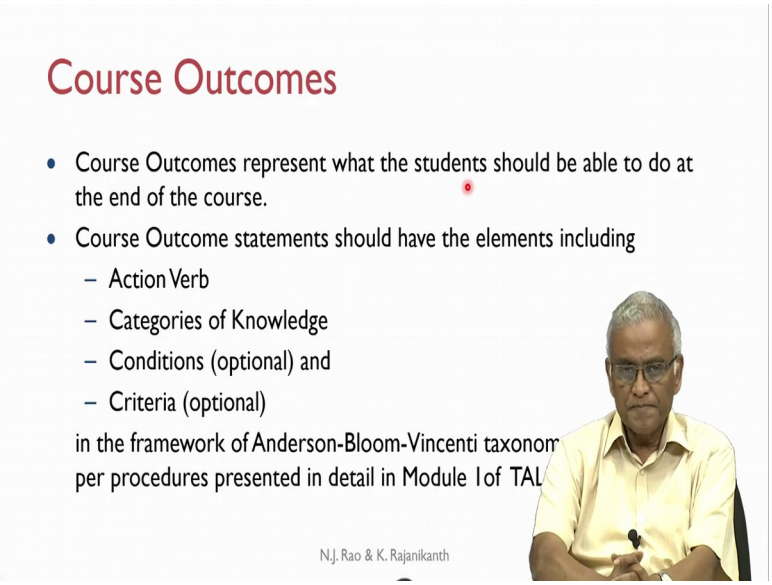

Course Outcomes: course outcomes present what the students should be able to do at the end of the course. We considered in detail how to write course outcome in Module 1 of TALE. We, therefore, are not elaborating the same at this point of time on how to write course outcomes?

The course outcome statement should have the elements: action verb, categories of knowledge, conditions which are optional, and criteria which are also optional. They are written in the framework of Anderson-Bloom-Vincenti taxonomy, and the procedures are presented in detail in Module 1 of TALE.

We expect that whoever is going through the Module 2, have the knowledge of Module 1, because we are not going to repeat all the aspects of taxonomy, and how to write course outcomes at this point of time.

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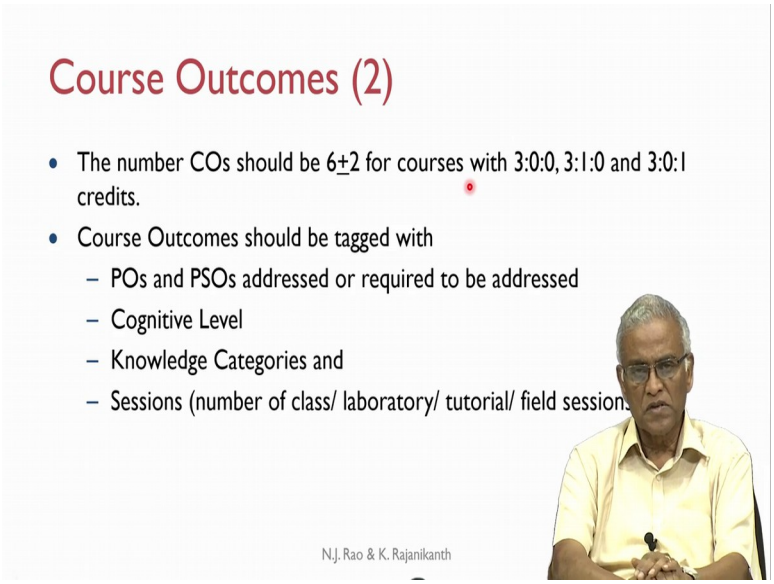

We also said the number of COs should be 6 plus or minus 2 for courses with credits 3:0:0; 3:1:0 and sometimes when the lab is integrated 3:0:1. And, if the number of credits are more or less you can also adjust the number of outcomes that you want to write. It was also mentioned that course outcome should be tagged with the POs and PSOs addressed.

By the cognitive level of a CO, we mean the cognitive level associated with the action verb used and we do not include the lower cognitive levels. With respect to knowledge categories even up to 4-5 categories out of the 8 knowledge categories may be addressed. The number of sessions include the number of class, laboratory, tutorial, field sessions you have.

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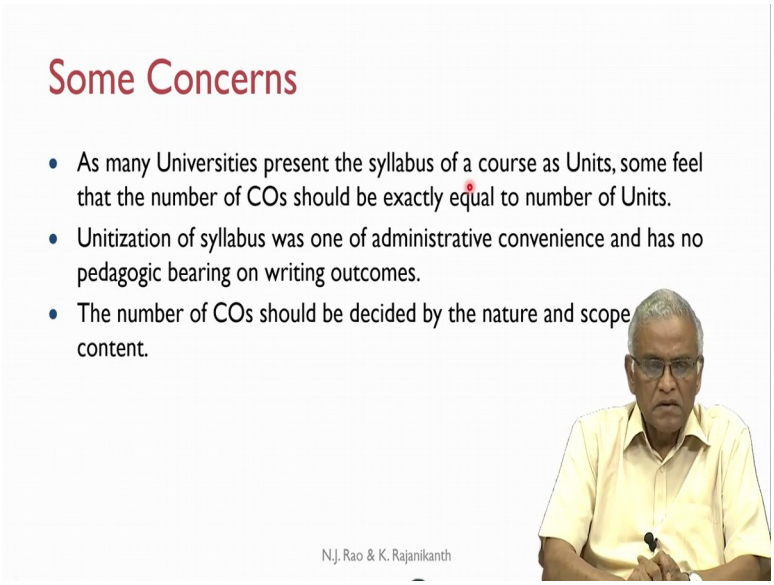

We have also stated so, many universities present their syllabus of a course as units - some feel that the number of COs should be exactly equal to number of units. As we elaborated in TALE - Module 1, there is no need for unitization of syllabus which is one of administrative convenience and has no pedagogic bearing on writing outcomes. That means, an outcome may go across the units, or one unit may have multiple outcomes and so on. Should not mix units with outcomes; the number of number of COs should be decided by the nature and scope of the content.

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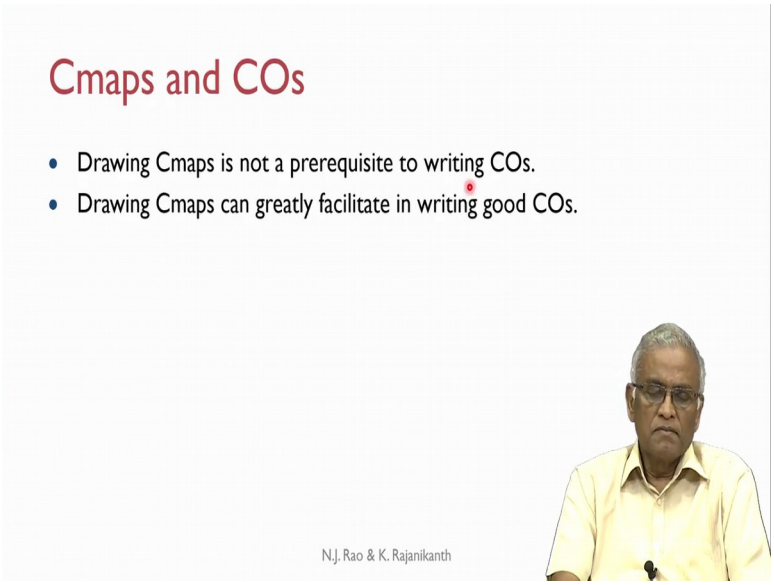

Cmaps and COs: Drawing Cmaps is not a prerequisite to writing COs. But drawing Cmaps can greatly facilitate your understanding of the course and help in writing good COs.

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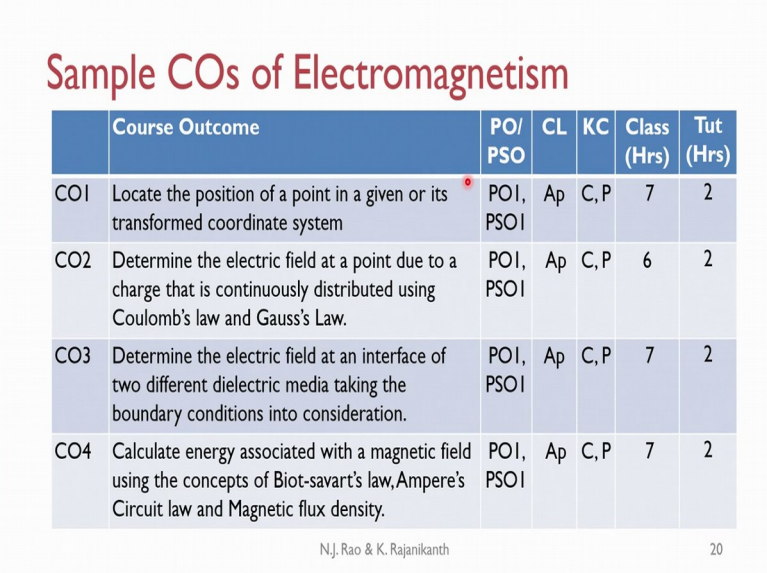

This is a sample COs of electromagnetism course. You write the CO and tag them with POs and PSOs addressed, cognitive level, knowledge categories, number of class sessions, and the number of tutorial hours.

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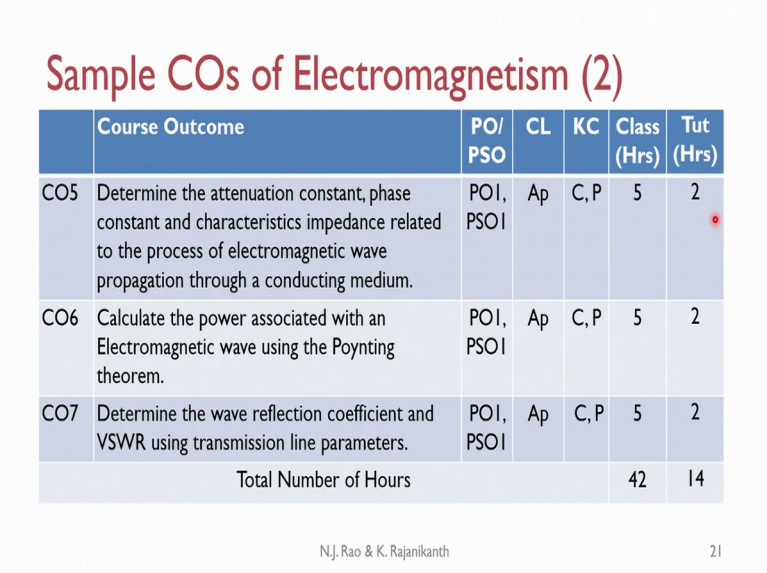

That is how we present complete course on electromagnetism.

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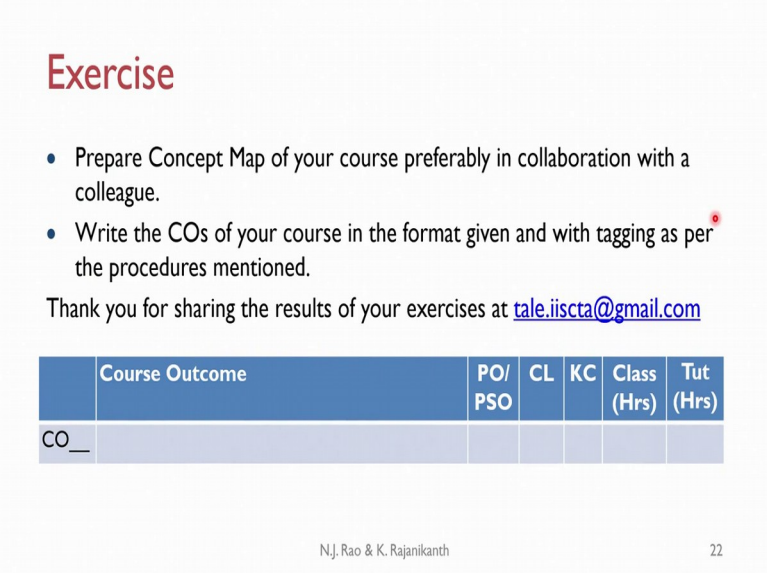

Please prepare a concept map of your course as I said it will be quite an enjoyable exercise, and preferably in collaboration with a colleague. Write the COs of your course in the format given with the tagging as per the procedure mentioned. This exercise was already given in the module 1. If you have already done that those can be carried forward here. The course outcome should be written in the kind of table that we gave you. We will be happy and will thank you if you can share the results of your exercise with us.

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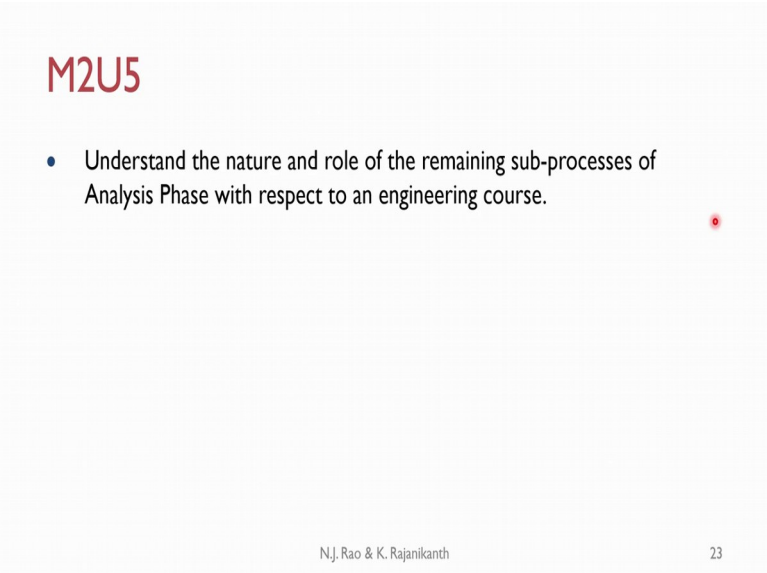

In the next unit we will look at the remaining sub-processes of analyze phase with respect to an engineering course. There are 4 or 5 other sub-processes; we will elaborate on that, which completes analyze phase in a systematic fashion.

Thank you very much for your attention.