NBA Accreditation and
Teaching – Learning in Engineering
(NATE)
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Lecture 11
Cognitive Processes

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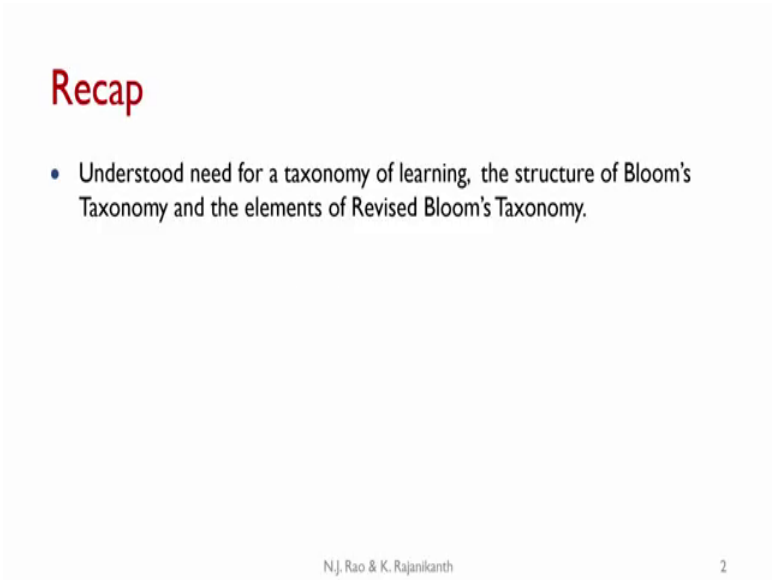

Greetings, welcome to module 1, unit 10 on Cognitive Processes. In the earlier unit, we understood the need for a taxonomy of learning the structure of Blooms Taxonomy and the elements of Revised Blooms Taxonomy.

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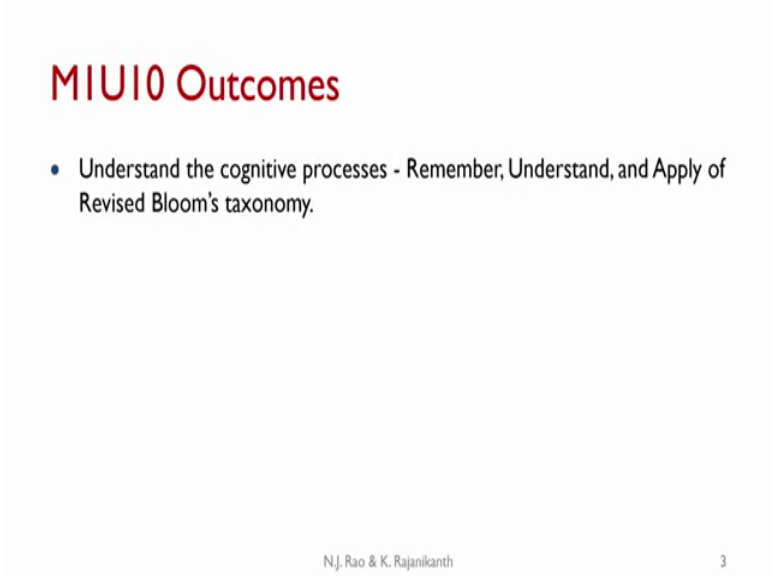

In this unit we will look at the cognitive process dimension, the outcome for this unit would be understand the cognitive processes of remember, understand and apply of revised blooms taxonomy.

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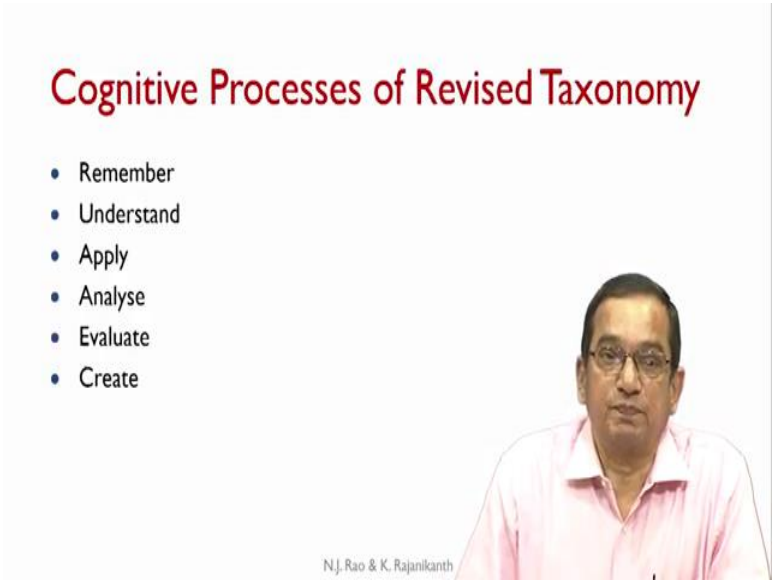

Recall that, the cognitive processes of revised blooms taxonomy are 16 number hierarchically organized, remember, understand, apply, analyse, evaluate and create.

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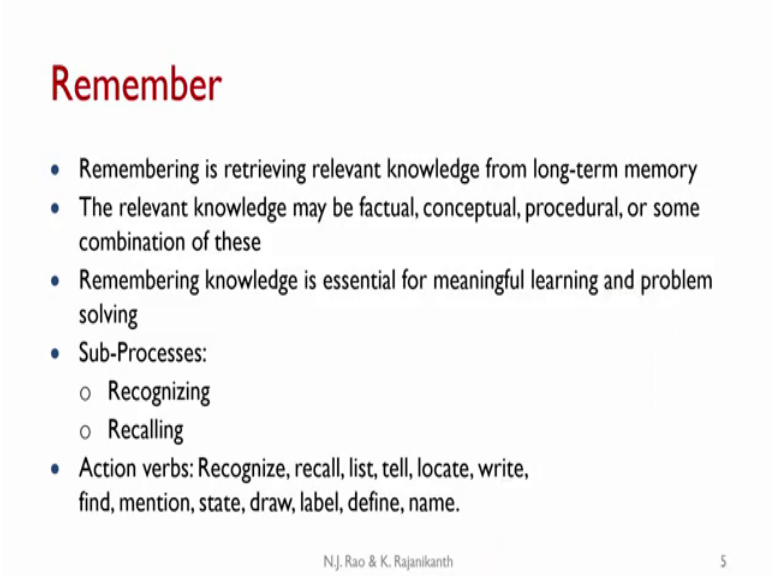

Remember, is the cognitive process of lowest complexity in the hierarchy, remembering is retrieving relevant knowledge from the long term memory. The relevant knowledge may be factual, conceptual, procedural, or some combination of this.

Remembering knowledge is essential for meaningful learning and problem solving. Thus even though remembering is a cognitive process of low complexity, it is an essential competency that learners must acquire and demonstrate. This process has two sub-processes recognizing, recalling.

Recognizing essentially means that the solutions are presented and the learner is able to recognize the correct response from the presented solutions. Recalling is recalling from long term memory based on certain key word that is provided to the learner, the associated action verbs are recognize or recall, list, tell, locate, write, find, mention, state, draw, label, define, name, we can continue with several such action verbs.

Primarily, this cognitive process means that the learner is recalling from the long term memory, what has been conveyed by the instructor earlier.

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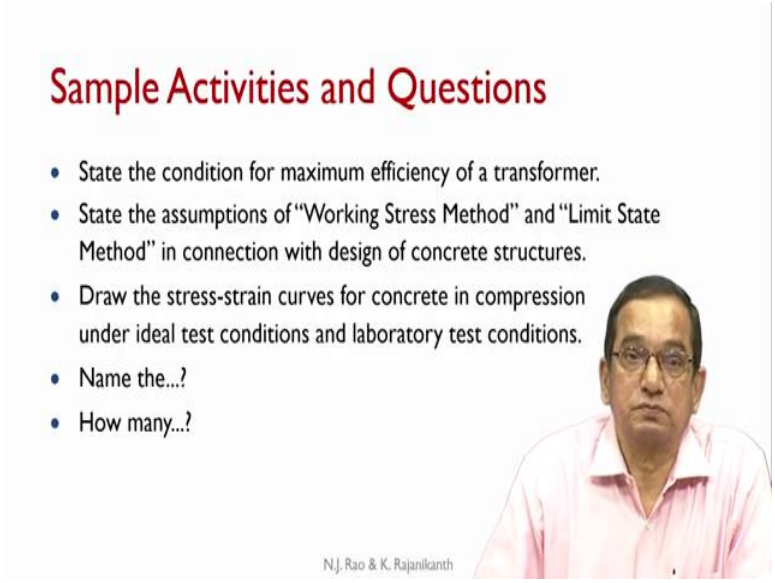

Sample activities and questions can be like this. State the condition for maximum efficiency of a transformer. The student can memorize and then recall from our long term memory, the condition for maximum efficiency of a transformer. State the assumptions of working stress method and limit state method in connection with the design of concrete structures. Draw the stress-strain curves for concrete in compression under ideal test conditions and laboratory test conditions.

We can have a stem like name the, we can continue it the way we want. Name the parts of this particular machine? Name the major units of a computer? So, we can have several variations with the common stem of name the, similarly another common stem can be how many. How many general purpose registers are there in a 886 microprocessors? How many primitive data types are there in C language?

We can have any number of variations like this, they all come under the remember cognitive process.

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The next higher level cognitive process is understand, as mentioned in the last unit understand is tricky, many teachers object to the use of understand in the outcome statement, they think that understand does not represent an observable behaviour of the learner. However revised blooms taxonomy does permit, the use of understand, understand is made very specific in the revised blooms taxonomy.

There are several sub-processes under the category of understand these sub-processes delimit the meaning of understand, they make this cognitive process in observable behaviour from the student. Thus, it is accepted in the revised blooms taxonomy to use the word understand. Understanding is constructing meaning from instructional messages. Instructional messages can be verbal, pictorial, graphic or symbolic.

Instructional messages are received during lectures, demonstrations, field trips, performances, or simulations, in books are on computer monitors. During any learning experience, the learner can be receiving the instructional messages and understanding is constructing meaning from such instructional messages.

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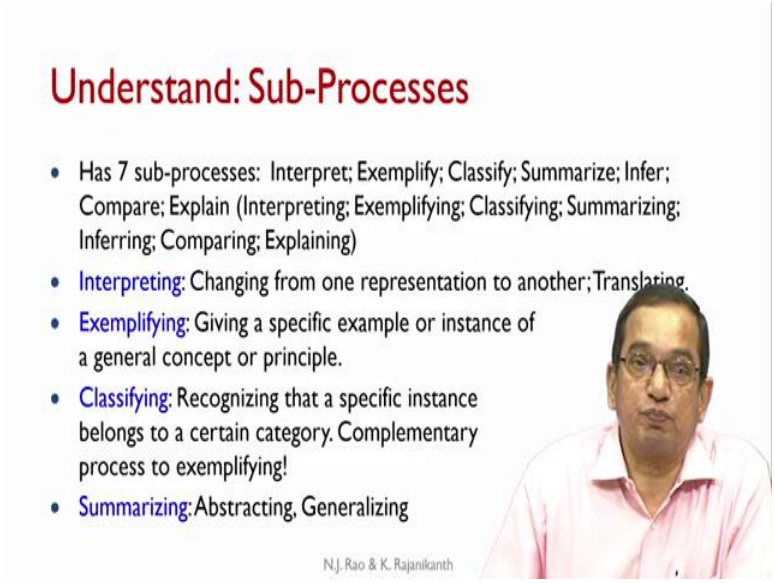

In the reverse blooms taxonomy, there are 7 sub-processes in the category of understand, they are, Interpret, Exemplify, Classify, Summarize, Infer, Compare and Explain. Interpreting, changing from one expression to another, is also known as translating. Typical learning experience would be that the student is given certain information in one form, student has to translate that into a different form definitely this would imply understand.

A typical example can be that the problem is presented in an English language and student has to formulate this as a linear programming problem, this is one example of interpreting. The next sub-category is exemplifying, giving a specific example or instance of a general concept or principle. Providing a specific example of a viscous fluid that we encounter in daily life. The categories given and the learner has to provide a specific instance belonging to that category.

The complimentary process is classifying, recognizing that a specific instance belongs to a certain category. Here, the instructor provides a specific instance and the learner has to identify the category to which that specific instance belongs. Summarizing, abstracting, generalizing.

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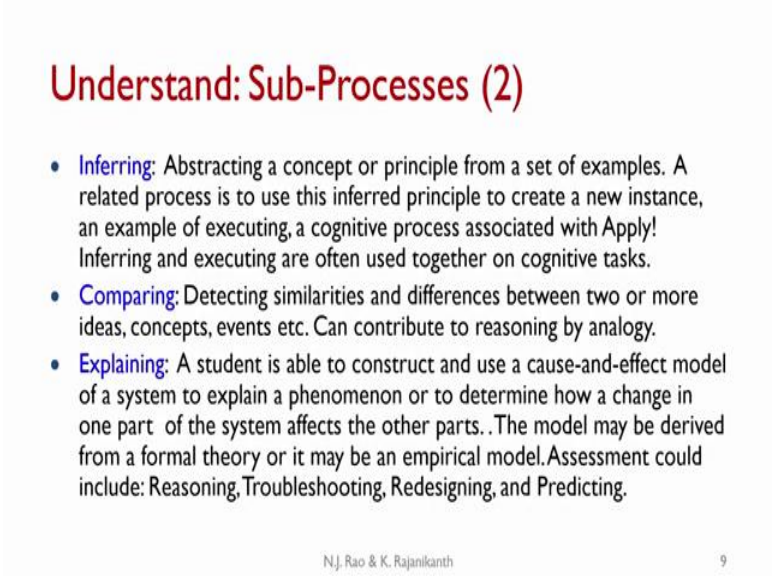

Inferring, abstracting a concept or principle from a set of examples. A related process is to use this inferred principle to create a new instance. An example of executing a cognitive process associated with apply, the next higher level category. Inferring and executing are often used together on cognitive tasks. Here, we have a series of specific instances and the learner has to infer the principle according to which these instances are being created.

So the cognitive sub-process involved is inferring. An example could be that the learner is presented with a series of numbers and she has to infer what is the rule based on which this series is being produced. If she can infer this rule, she can create the next numbers in the sequence. The next sub-process is comparing, detecting similarities and differences between two or more ideas, concepts, events, etc. This can contribute to reasoning by analogy also.

Then the next sub-process is explaining, people use the word explained in a very generic sense, but explaining in the revised blooms taxonomy has a very specific meaning, a student is able to construct and use a cause-and-effect model of a system to explain a phenomenon or to determine how a change in one part of the system affects the other parts.

The key word here is cause-effect model, the student must be able to construct a cause-and-effect model of a system. The model may be derived from a formal theory or it may be an empirical model. A variety of assessment strategies are possible with respect to this sub-process. Assessment could include, reasoning, troubleshooting, redesigning and predicting. The assessment could include, for example, description of a system, which is not functioning the way it is expected to function.

The specific behaviour is described by the instructor. The learner has to figure out the reason why the system is behaving in that particular fashion. An example of troubleshooting are the systems behaviour is described. And an intended change in the behaviour is also specified and learner has to be is in the system.

So, that also would come under explaining, notice that this if it is extended further, can move into the applied category also. So, there are several possibilities of assessing the students understanding in this particular sub-category.

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The action verbs associated with the understand process, for interpreting, translate, paraphrase, represent, clarify. For exemplifying, illustrate, instantiate. For classifying, categorize, subsume. For summarizing, generalize, abstract. For inferring, find a pattern, extrapolate, predict. For comparing, contrast, compare, match, distinguish, differentiate there can be several such action verbs. For explaining, construct a model, explain itself can be used as the action verbs.

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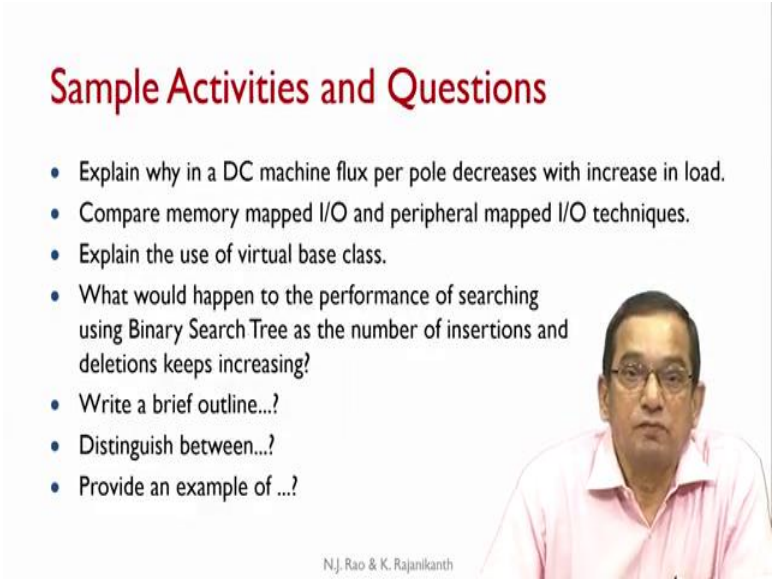

Some sample activities and possible question formats. Explain why in a DC machine flux per pole decreases with increase in load? The student must construct cause-and-effect model and explain this stated phenomenon. Compare memory mapped I/O and peripheral mapped I/O techniques. Explain the use of virtual base class? What would happen to the performance of searching using binary search tree as the number of insertions and deletions keeps increasing?

Write a brief outline, we can continue this question in several different ways, distinguish between we can use certain number of categories, provide an example of specify a category and the learner has to provide an example of it. Provide an example of emerging properties. These are all the possible formats.

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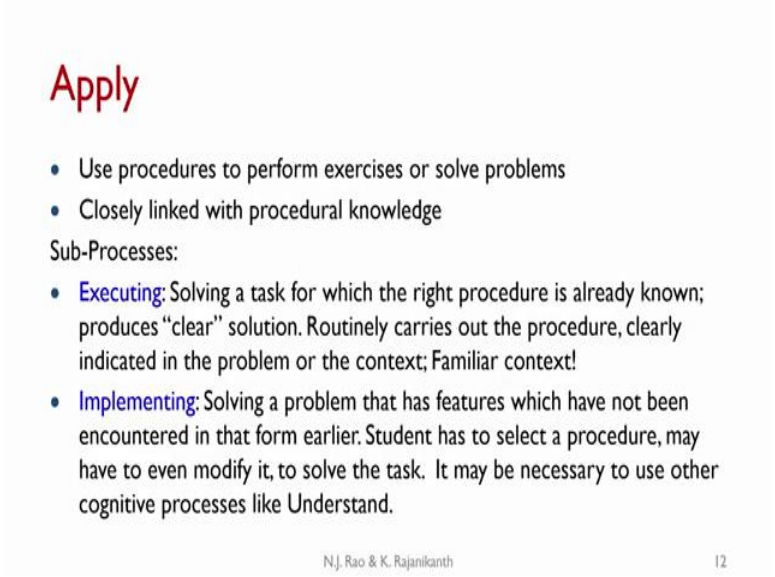

The next higher cognitive process is apply, use procedures to perform exercises or solve problems. This is closely linked with procedural knowledge. There are two sub-processes associated with apply, executing, implementing. Executing, solving a task for which the right procedure is already known, this produces clear solution. Routinely carry out the procedure, clearly indicated in the problem itself or the context.

And the context is familiar in the sense that the assessment context is quite similar to the instructional context, the teacher has explained a particular procedure. The teacher has explained how to solve a specific problem using that particular procedure and the learner executes that procedure to solve a very similar problem. The next sub-process is implementing.

This implies solving a problem that has features which will not been encountered in that form earlier. That means, the context in which the learner is operating is somewhat different from the instructional context, student has to select a procedure may how to even modify it to solve the task.

It may be necessary to use other cognitive processes like understand, learner may help to understand the context, the problem, the conditions implied in order either select a procedure or modify a procedure if the learner has to solve the problem. Thus, the learner is operating beyond the context which was present during the instruction.

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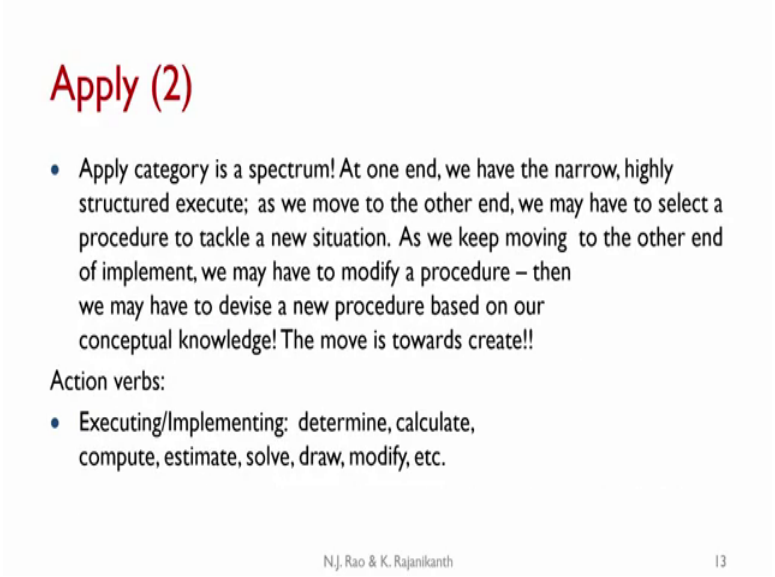

Thus we can see that apply category is a spectrum. At one end, we have the narrow, highly structured execute, as we move to the other end, we may have to select a procedure to tackle a new solution, a new situation. As we keep moving along the spectrum to the other end of implement, we may have to modify a procedure then we may have to devise a new procedure based on our conceptual knowledge.

And thus we are moving gradually towards the cognitive process of create itself. Thus, apply is a spectrum. At one end, there can be a very routine execution of a known procedure in a known context to solve a problem that is quite familiar. At the other end of the spectrum, it may involve considerable talent on the part of the student to use our conceptual knowledge to come out with a modified procedure or a new procedure to solve a problem, which she is encountering probably for the first time in that specific form.

Thus the capabilities, the competencies implied by apply can be fairly wide from a narrow highly structured execute to fairly complex process of implement, which is at the other end of apply the action verb associated with the applied cognitive process will be determined, calculate, compute, estimate, solve, draw, modify etc. Notice that the action verb remains the same whether we are operating at the low end of the apply or high end of the apply.

Whether the problem is something which the learner is completely familiar are the problem is something which the learner is not all that familiar with, we might use the same action verb of determine, the instructor has to decide what should be the scope of apply activity.

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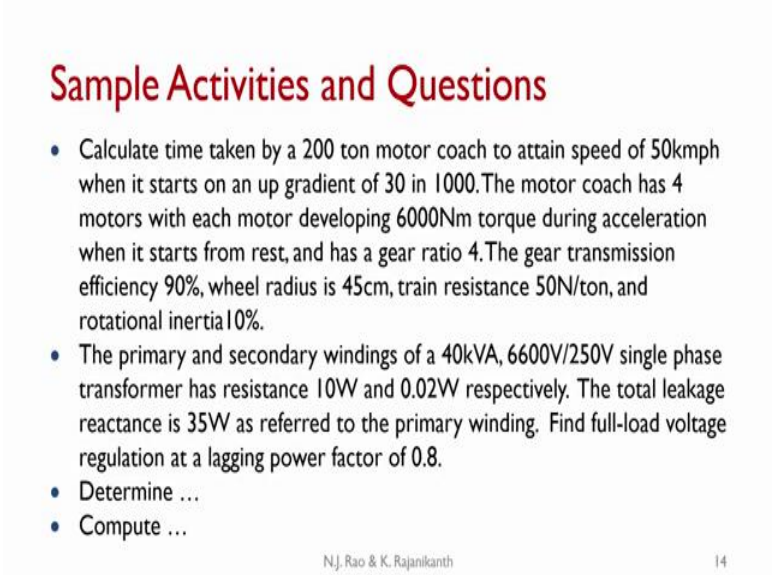

Sample activities and questions, calculate time taken by a 200 ton motor coach to attain speed of 50 kilometres per hour, when it starts up gradient of 30 in 1000. The motor coach has 4 motors with each motor developing 6000 newton meter torque during acceleration when it starts from rest and has a gear ratio of 4. The gear transmission efficiency is 90 percent, wheel radius is 45 centimetres, train resistance 50 newton per ton and rotation inertia 10 percent.

This might be the low end of apply or high end of a apply depending upon what the instructional context was, whether the learner is completely familiar with problems of this type or whether the learner is encountering a problem of this specific nature for the first time these aspects will determine at which end of the apply spectrum the learner is operating.

Another example can be the primary and secondary windings of a 40 Kva, 6600 volts by 250 volt single phase transformer has resistance of 10 watts and 0.02 watts respectively. The total leakage reactance is 35 watts as referred to the primary winding. Find full-load voltage regulation at a lagging power factor of 0.8. The general stem can be determine, so we can continue this in several different ways. Compute, again we can continue this in several different ways.

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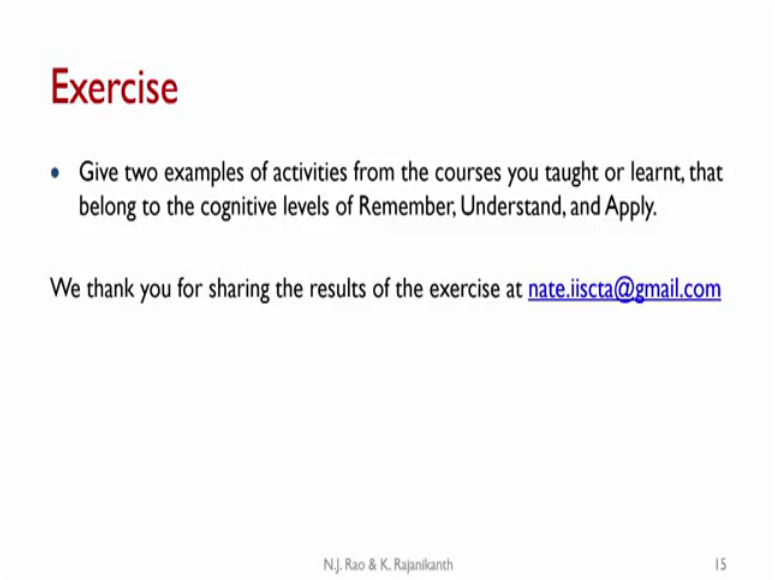

Exercise, give two examples of activities from the courses you taught or learnt that belong to the cognitive levels of remember, understand and apply. We thank you for sharing the results of the exercise at nate.iiscta@gmail.com

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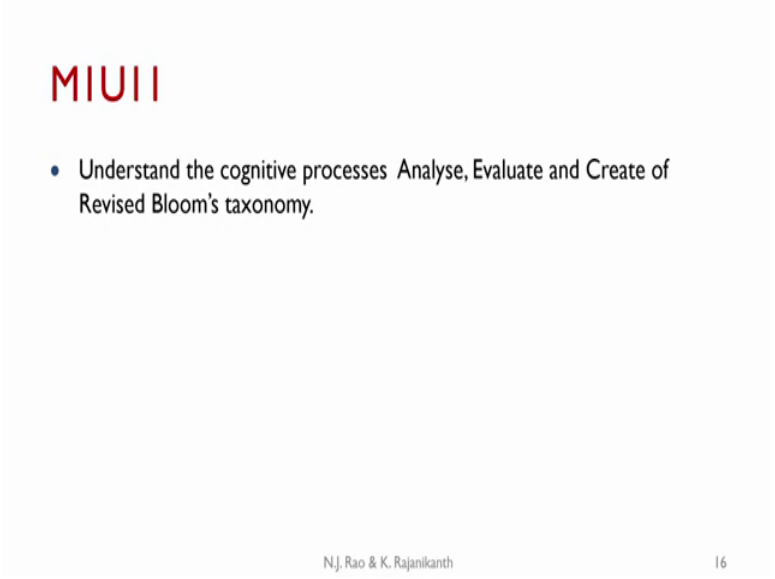

In the next unit will look at the remaining cognitive processes of revised blooms taxonomy will understand the cognitive process of analyse, evaluate and create. Thank you, we will meet in the next unit, thank you.