NBA Accreditation and Teaching - Learning In Engineering (NATE)
Professor K. Rajnikanth
Retired Principal
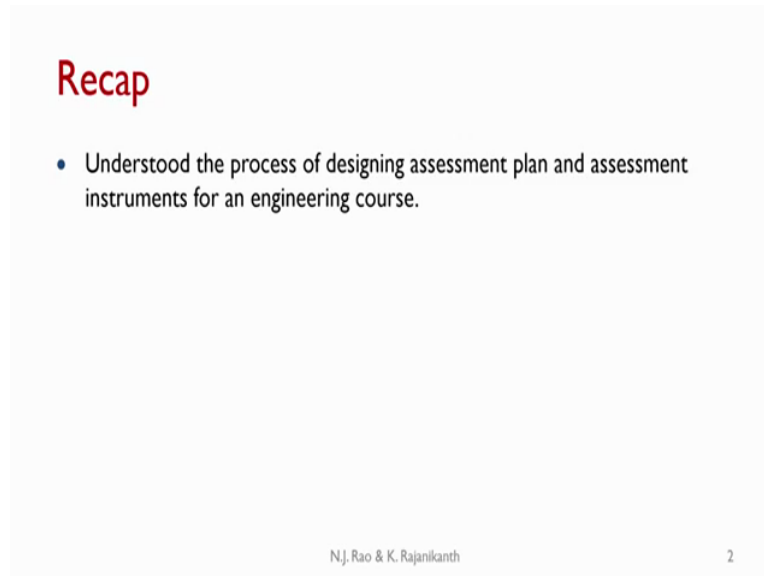**MS Ramaiah Institute of Technology**
Department of Electronics Systems Engineering
Indian Institute Of Science, Bengaluru
Item Banks

Greetings, welcome to module 2, unit 8 on item banks.
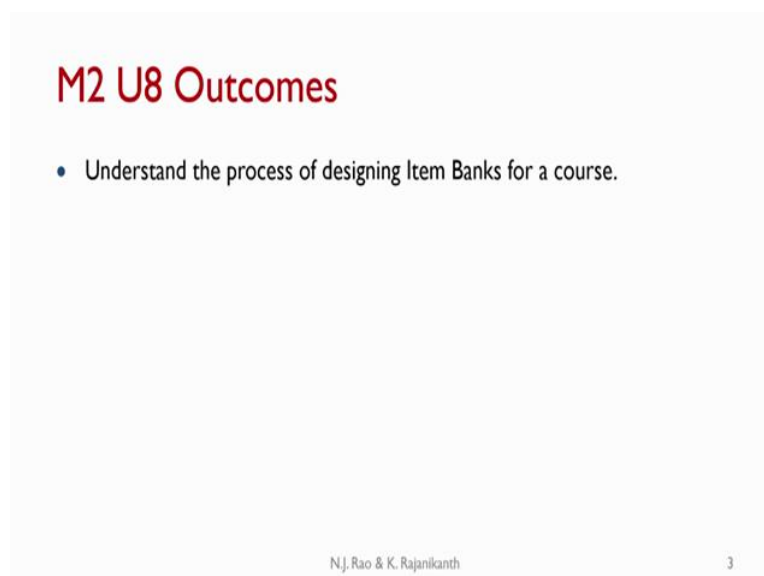
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Recap

- Understood the process of designing assessment plan and assessment instruments for an engineering course.

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In the earlier unit, we understood the process of designing assessment plan and assessment instruments for an engineering course.

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M2 U8 Outcomes

- Understand the process of designing Item Banks for a course.

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In this unit will understand the process of designing item banks for a course.

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What is an item bank? Item bank is also known as question bank in popular usage. What is it? It is a collection of assessment items organized according to the course outcomes and cognitive levels. What is the purpose of an item bank? The purpose of an item bank is to meet the needs of designing assessment instruments for quizzes, assignments, tests of CIE and SEE.

Accordingly, we can help item banks separately for quizzes, assignments, and CIE tests as well as for SEE. It would be more convenient to have item banks separately because the requirements do vary slightly from quizzes to assignments to tests.

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Items included in an item bank need to go through a formal preferably or informal at least, review process. This is extremely important. The whole purpose of an item bank is to facilitate composing quality assessment instruments. That will be possible only if the assessment items included in the item bank are of good quality.

Thus all items included in the item bank must be reviewed and after going through such a review process only the item banks must be created. If the item bank is to serve the purpose of creating quality assessment instruments, we must ensure that the assessment items in the item bank are of good quality.

Thus, items included in the item bank must go through a review process. Items are tagged with several parameters. We will presently see the parameters. Item bank needs to be organized as a database if assessment instruments are to be generated using software tools. If we organize th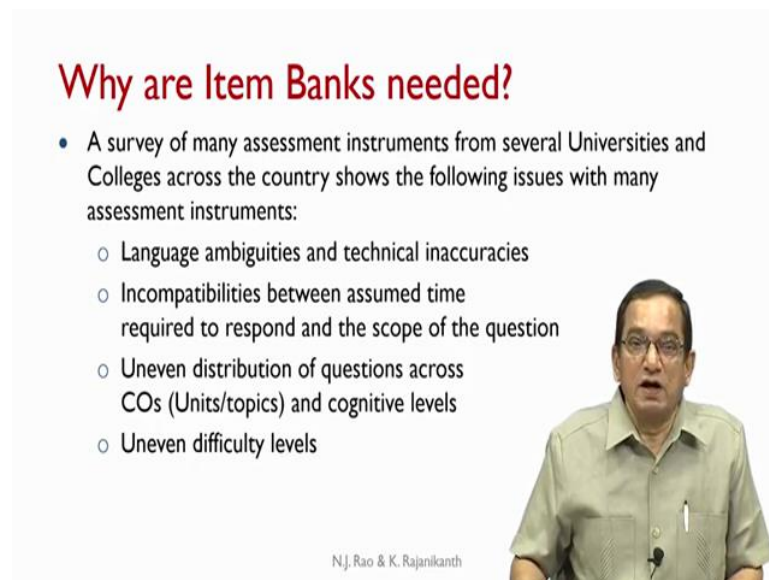e item bank as a database, it is possible to have the assessment instruments generated automatically through appropriate tools. Even if we are not planning to use any tools to automate the process of generating assessment instruments, an item bank should be structured well for manual use also.
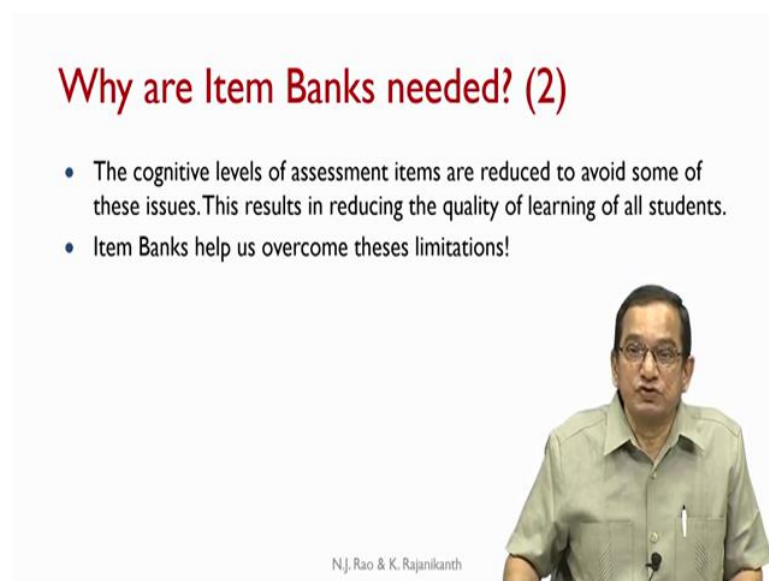
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Why do we need the item banks? A survey of many assessment instruments from several universities and colleges across the country shows the following issues with many assessment instruments. Many of these assessment instruments are available in the relevant websites and a survey would show that many of the assessment instruments do help some serious problems.

There are language ambiguities, and technical inaccuracies. There are incompatibilities between the assumed time required to respond and the scope of the question. This generally leads to the compliant from the students that the question paper is too long, or the questions take abnormally long time to respond.

They claim that they knew the answer, but could not complete it in the given time, and even distribution of questions across course outcomes or you could also say units and topics and cognitive levels. Certain COs which consume several classroom sessions are addressed very very weakly in the assessment instrument. Certain COs which did not require that many classroom sessions are given undue importance in the question paper.

So, this kind of unevenness in the distribution of the questions across the COs can also be noticed in several assessment instruments. And even difficulty levels also exist among the questions. So, these are some of the issues which one can notice when one surveys the available assessment instruments from several universities as well as colleges across the country.

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The cognitive levels of assessment items are sometimes reduced to avoid some of these issues. This would be a poor way of composing the assessment instrument. Reducing the cognitive levels of assessment items, with the hope that this would reduce or avoid some of the issues stated already is a poor way of composing an assessment instrument.

This results in reducing the quality of learning of all students. Item banks help us overcome these limitations. It is not that the item bank is a panacea and automatically it will ensure

good quality question paper. But item banks do help the instructors compose assessment instruments have much better quality

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Advantages in having Item Banks

While it takes considerable effort to create good item banks for first time, there are several advantages in having a good item bank.

- Faculty can save considerable time while designing good quality quizzes and class tests.
- Paper setters at the University level can greatly benefit from an item bank when setting assessment instruments of good and uniform quality.
- Some or all of the processes associated with creating and administering assessment and evaluation can be computerised.

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Advantages in having an item bank. While it takes considerable effort to create good item banks, particularly for the first time, there are several advantages in having a good item bank. Faculty can save considerable time while designing good quality quizzes and class tests. Paper setters at the university level can greatly benefit from an item bank when setting assessment instruments of goods and uniform quality at the level of semester end examination.

Some or all of the processes associated with creating and administering assessment and evaluation can be computerized. If the item bank is available as an electronic database with appropriate tools or with facilities provided by certain learning management systems, it is possible to automate the process of composing the assessment instruments. It is also possible to automate the evaluation in some cases. These would reduce the effort and the time that presently gets devoted to the process of assessment and evaluation.

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If you look at the nature of the engineering institutions in India, we already have noted earlier also that we have tier 1 and tier 2 colleges, with tier 2 colleges being dominant. Item banks for tier 2 colleges, we can have item banks for quizzes, assignments and class tests. These item banks are created and managed by a teacher or a group of teachers.
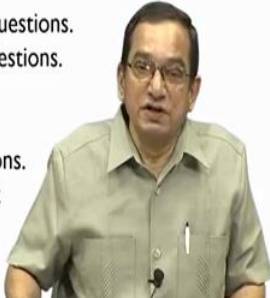
Item banks for SEE are created and managed at the university level because in a tier 2 college, the semester and examination is the responsibility of the university. So, the item banks for CIE assessment instruments are managed at the college level and the item bank for SEE are created and managed at the university level.

For tier 1 colleges, all summative instruments are the responsibility of the department itself. Thus, item banks for all summative instruments are created and managed by a teacher or group of teachers at the department level. So, the item banks for tier 1 college will help summative assessment instruments, all of them.

Assessment Items

- A wide variety of assessment items is possible as noted in an earlier unit.
- Quizzes mostly use objective (Select / Supply) questions.
- Some times, internal tests also may have some objective type questions.
- Some universities require SEE Question Paper to have a part that is composed of objective type questions.
- Such objective questions are typically 1-mark questions. Occasionally, these may be 2-mark questions.
- Mostly, "Remember" and "Understand" are the cognitive levels associated with objective questions. Occasionally, we may have objective questions at "Apply" level also.

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What kind of assessment items get into the item bank? A wide variety of assessment items is possible as noted in an earlier unit. We can objective questions, essay type questions, short answer questions, we can have true or false type questions, fill in the blanks, completion type of questions. A wide variety of assessment items is possible.

Quizzes mostly use objective to questions, select or supply type. Sometimes, internal tests also may have some objective type questions. Some universities require SEE question paper also to have a part that is composed of objective type of questions. For example, there are some universities where the SEE has 20 marks consisting of objective type questions, and 80 marks consisting of essay type questions.

Such objective questions are typically 1 mark questions. Occasionally, there may be 2 mark questions. These questions are mostly at, remember an understand level. The cognitive levels associated with these kind of objective questions are generally remember and understand. Occasionally we may have objective questions at apply level also.

Assessment Items (2)

- Marks allocated to assessment items used in Assignments, Internal Tests and SEE depend on specific Assessment Plans as discussed in an earlier unit. They may range from 1 mark to 20 marks! (with or without scaling of responses at the end).
- Assessment items in Assignments tend to be mostly at "Apply" or higher cognitive levels including "Analyze", "Evaluate" and "Create". Depending on the context some assignments may have items belonging to Understand or even Remember cognitive levels.
- Assessment items used in Internal Tests and SEE tend to be at the levels of "Remember", "Understand", or "Apply" only.

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Marks allocated to assessment items used in assignments, internal tests and SEE depend upon specific assessment plan as discussed in the previous unit. They may range from 1 mark to 20 marks, with or without scaling of responses at the end. Assessment items do vary considerably in terms of the marks allocated when we come to the instruments of assignment class tests or semester end examination.

Assessment items in assignments tend to be mostly at apply or higher cognitive levels including analyse, evaluate and create. This is because the assignments are take home assignments and students are expected to devote considerable time at home to compose responses for these assessment items.

Thus assessment items tend to be at higher cognitive levels when assignments are concerned. Depending upon the context, some assignments may have items belonging to understand or even remember cognitive levels, but that is extremely rare. Assessment items used in internal tests and SEE tend to be at the levels of remember, understand or apply only.

This is because these instruments are of limited time and it is very difficult to have assessment items of higher cognitive levels in these limited fixed time assessments. Thus the questions which are found in test or SEE tend to be always at remember, understand or apply level only.

Creation of Item Banks

- No unique way of creating the Item Bank.
- Here, we discuss general principles and useful guidelines.
- The examples presented are for the purpose of illustration only.
- Each institution must develop its own process for creating the item banks.
- The size of the Item Bank and the variety of assessment items in the Item Bank grow with time.
- However, initially, an Item bank must have some minimum number of items before it can be used effectively for composing assessment instruments.

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So, when we come to creation of the item banks, there is no unique way of creating the item bank. That is the first point to be noticed. What we are discussing are the general principles and useful guidelines. The examples presented are for the purpose of illustration only. Each institution must be develop its own process for creating the item banks.

There is a huge variety of assessment items which can get into the item bank, the number of marks allocated to the assessment items, the cognitive levels associated with the items, the total number of items created in the item bank, all these are all variables. So, an institution must have a policy for creating an item bank.

The size of the item bank and the variety of assessment items in the item bank grow with time. However, initially an item bank must have some minimum number of items before it can be used effectively for composing quality assessment instruments. In the subsequent years, the item banks will grow in size and also in the variety of assessment items that are available in the item bank. But initially, it must be a certain minimum size before it can be really used for composing assessment instruments of good quality.

Creation of Item Banks (2)

- Items addressing the same CO at the same cognitive level and having the same number of marks are considered to be in one category.
- Suggested minimum number of items in each category = 5 * Required number in that category.
- Required number of items depends on the Assessment Plan as discussed in an earlier unit.
- It is suggested that the item bank be made more general than required strictly by the assessment plan. This would make the item bank more useful in the long run.

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Items addressing the same CO at the same cognitive level and having the same number of marks can be considered to be in one category. All the questions for 6 marks, at understand level, addressing a particular CO, let us say CO 5, can be considered to be in one category. Now, we are suggesting that the minimum number of items in each such category be at least 5 times the required number in that category.

The required number of items depends on the assessment plan as discussed in the previous unit. So, based on the assessment plan, we work out what is the required number of assessment items of one category, then at least 5 times that number should be in the item bank to start with.

It is suggested that the item bank be made more general than required strictly by the assessment plan. This would make the item bank more useful in the long run. As an example, in the assessment plan, test 1 may address only CO1, CO2 and CO3 and all of the questions related to them maybe only at understand level. However if CO3 is at apply level, it would be worthwhile to create certain assessment items at apply level also and have them in the item bank.

Item Banks for Quizzes

- Quizzes are used both for formative and summative assessment.
- Quizzes normally consist 5 to 10 one-mark questions
- All quiz questions belong to Remember or Understand cognitive level.
- If all quiz items belong to categories that can be readily evaluated automatically by a tool like an LMS, the quizzes can be very conveniently administered and evaluated. The results can be discussed in the classroom without any delay, after the quiz is administered.

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Now, let us look at item banks for quizzes. Quizzes are used both for formative and summative assessment. In this sense, they are slightly different from the tests. Quizzes normally consist of 5 to 10 one mark questions. All quiz questions belonging to remember or understand cognitive level. In principle, one could have an objective type question at apply level.

But a quiz generally will have questions belonging only to remember or understand cognitive levels. If all quizzes items belong to the categories that can be readily evaluated automatically by a tool like a learning management system, the quizzes can be very conveniently administered and evaluated. Multiple choice questions, multiple select questions, fill in the blank from a list of given words, these are the type of assessment items, which can be very conveniently evaluated by a tool.

If such is the case, the results can be discussed in the classroom without any delay after the quiz is administered. Feedback can be provided to the students practically immediately after administering the quiz. And we will see later that providing such timely feedback to the students contributes to better learning by the students. Thus if we can have quiz items which can be evaluated by a tool, it is worthwhile to have such quizzes as frequently as possible.

There are 5 quizzes and 5 questions per quiz, then total questions required would be 25. If at least 5 times the required number of questions are to be included in the item bank, then we need to have about 125 items. This is a rough calculation, an approximate figure and this figure holds good for the initial configuration of the item bank.

Subsequently the item bank will grow in size. The items in the quiz bank are to be distributed over all the COs approximately in proportion to the number of class sessions associated with each CO. If a particular CO consumes fairly large number of classroom sessions, then it is worthwhile having fairly larger proportion of the items belonging to that CO.

So, that is how we create the item bank initially. Subsequent years, we will keep on adding items to the item bank and the item bank will continue to grow in size. The items in the item bank for quizzes can be distributed suitably over the relevant cognitive levels of remember as well as understand.

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Item Banks for Assignments

- Assignments dominantly will have items belonging to the cognitive level "Apply".
- In some cases, ill-defined problems and items belonging to Analyze, Evaluate and Create categories can be given as assignments.
- Marks allocated to the items for assignment vary considerably.
- We must decide on the number of items, their cognitive levels, and the marks to be allocated to them based on the assessment plans.

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Let us look at the item banks for assignments. Assignments dominantly will have items belonging to the cognitive level, apply. In some cases, ill-different problems and items belonging to analyse, evaluate and create categories can be given as assignments. It is very difficult to include assessment items of this nature in limited time assessment instruments like tests.

Thus, the instructor may decide to help such items included in assignments. Marks allocated to the items for assignments vary considerably. We must decide on the number of items, their cognitive levels, and the marks to be allocated to them based on the assessment plans. That would indicate the size required for the item bank.

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Item Banks for Assignments (2)

- If on the average there are three items in an assignment, two assignments in a semester, and the number items in the item bank needs to be at least five times the required number initially, then the number of items in Assignment Item Bank should be 30.
- The items should be designed to address all the COs of the course at the concerned cognitive levels.
- Items must be designed taking into account the cognitive levels as well as the marks to be allocated to them.
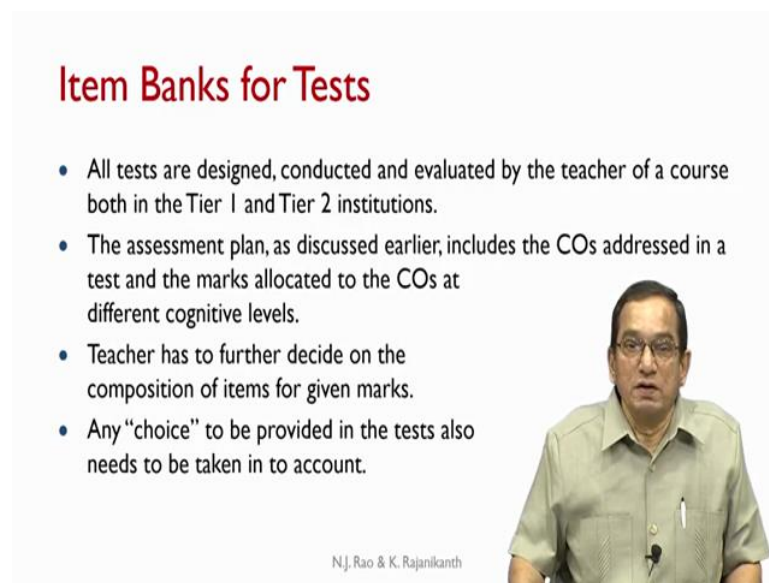
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Again, if we assume that on the average there are 3 items in an assignment, 2 assignments in a semester, and the number of items in the item bank needs to be at least 5 times the required number initially, then the number of items in the assignment item bank should be 30, 3 items in assignment into 2 assignments, that is 6 items, and we need 5 times that, so 30 items.

The items should be designed to address all the COs of the course at the concerned cognitive levels. Of course this is a choice of the instructor. If he feels very strongly that some COs are unlikely to be included in assignments, then she need not create items for those COs. For example, in many courses, the earlier COs tend to be at slightly lower cognitive levels.

So, there may not be any requirement to include those COs in assignments, say CO1, CO2, or even CO3. So, a particular faculty member might decide to have assessment items related only to the later COs for the assignments, it is the choice of the instructor. Items must be designed taking the account the cognitive levels as well as the marks to be allocated to them.

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Let us now look at items banks for tests. All tests are designed, conducted and evaluated by the teacher of a course, both in tier 1 and tier 2 institutions. The assessment plan, as discussed earlier, includes the COs addressed in a test and the marks allocated to the COs at different cognitive levels. Teacher has to further decide on the composition of items for the given marks. Any choice to be provided in the test also needs to be taken into account.

Item Banks for Tests (2)

Example:
- Consider the assessment plan presented in the earlier unit.
- As per that plan, CO5 is addressed in Test 2; marks allocated are 8; and their break up is: 6 marks at "Apply" level and 2 marks at "Understand" level.
- Teacher decides to have 2 questions at "Apply" level, each for 3 marks, to get a total of 6 marks for that level and one question of 2 marks at "Understand" level.
- There is to be internal choice. Both the questions involved in the choice are to be similar.

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Let us look at one example. Consider the assessment plan presented in the previous unit. As per that plan, CO5 is addressed in test to. Marks allocated to CO5 are 8 and their breakup is 6 marks at apply level and 2 marks at understand level. Now, how does one compose a question for 6 marks at the apply level? Teacher again has great freedom.

Teacher can decide to have help one single question for 6 marks at apply level or teacher can decide to have 2 questions at apply level, each for 3 marks. So, thus teacher has to decide how many sub questions at how many marks level should be used to compose the question required as per the assessment plan.

In this case, let us assume that teacher decides to have 2 questions at apply level, each for 3 marks to get a total of 6 marks for that level. And one question for 2 marks at understand level. Again, it is to be noted that this is the decision of the instructor. She has the total freedom on the decision regarding the composing of the questions. The total marks at apply level must be 6. Beyond that, the actual composition of the question is left to the specific teacher's choices made in a particular rendering of the course. There is to be internal choice. Both the questions involved in the choice or to be similar. These are the decisions made.

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Item Banks for Tests (3)

Example (continued):

Items required CO5, for Test 2, taking choice in to account:

- 4 questions, each for 3 marks, at "Apply" level.
- 2 questions, each of 2 marks, at "Understand" level.

Item Bank requires:

- 5 * 4 = 20 questions, each for 3 marks, at "Apply" level.
- 5 * 2 = 10 questions, each for 2 marks, at "Understand" level.

Total requirements for Item Banks for tests can be determined by considering all the COs and all the tests as per the assessment plan.

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So now, what should be the number of items in the item bank? Items required for CO5 for test 2, taking choice into account. 4 questions, each for 3 marks at apply level. Notice we needed 2 questions, each for 3 marks, but there is an internal choice. So, we need 2 plus 2, 4 questions. Then 2 questions each of 2 marks at understand level. So, item bank requires 5 into 4, 20 questions, each for 3 marks at apply level and 5 into 2, 10 questions, each for 2 marks at understand level.

The total requirements for item banks for tests can be determined by considering all the COs and all the tests as per the assessment plan. This is an illustrative process for one particular CO and for one particular test. This has to be done for all the COs and all the planned test. That would indicate how the item bank should be created in the first instance.

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Features of Item Banks for Tests

- Teacher makes the choices at every stage.
- The choices are based on her perception of the subject, her instruction, cognitive abilities of students, and other contextual factors.
- One structure is not applicable to all courses.

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Features of item banks for tests. Teacher makes the choice at every stage. The choices are based on her perceptions of the course, the subject content, her instruction, cognitive abilities of students, and other contextual factors. One structure is not applicable to all courses, nor does the item bank impose any kind of restrictions on the teacher.

It is not a straitjacket. The creativity of the teacher is in no way compromised. There are several decisions which are made by the teacher based on the contextual factors. The item bank for test still helps the teacher in creating quality assessment instrument, but it does not confirm freedom.

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Item Banks for SEE

- SEEs are more structured than tests.
- Normally one structure is used for all courses of all programs.
- Paper setter (University) and Teacher (Tier 1 Institution) has the choice of distributing the marks allocated to a question over three or four sub-questions.
- Initial Item Bank can be designed with five times the required number items after taking "choice" into account.

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Now, let us look at item banks for semester end examination. SEEs are more structured than tests. Normally, one structure is used for all courses of all programs in a given institute or a given university. Paper setter at the university level or teacher in the case of a tier 1 institution, has the choice of distributing the marks allocated a question over 3 or 4 sub questions.

Most of the universities and institutions in India in an implicit way, restrict the number of questions, sub questions to 4. A given question does not have more than 4 sub questions. Initial item bank can be designed with 5 times the required number of items after taking choice into account.

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Sample Structure of SEE Instrument

CO	CL	Item A	Item B
CO1	U	1A - 6U+4U	1B - 6U+4U
CO2	U	1A - 6U+4U	1B - 6U+4U
CO3	Ap	2A - 4U+8Ap+8Ap	2B - 6U+6Ap+8Ap
CO4	Ap	3A - 6U+7Ap+7Ap	3B - 5U+8Ap+7Ap
CO5	Ap	4A - 4U+8Ap+8Ap	4B - 4U+8Ap+8Ap
CO6	Ap	5A - 4U+8Ap+8Ap	5B - 4U+8Ap+8Ap

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This is one sample structure of an SEE instrument. This is internal choice, the assessment items under the column item A and the assessment items under the column item B are the choice groups. For CO1, there is a 6 mark question at understand level. There is a 4 mark question again at understand level. That is how the 1A is shown as 6U plus 4U.

That means 6 marks at understand level. Another question for 4 marks at understand level. Then the same question addresses CO2 also. And regarding CO2 also, there is one question for 6 marks at understand level, there is one question for 4 marks at understand level. Thus overall, if you look at the first question, there are 4 subsections to that question, or 4 sub questions to that question.

One question is at 6 marks, another one is at 4 marks, these two are related to CO1. Then there is one sub question at 6 marks and another sub question at 4 marks, all at understand

level related to CO2. So, this constitutes one question and the internal choice for this question is the one which is shown under the item B column.

That is, 1B with 6, 4, 6, 4 marks, all at understand level, 2 sub questions belonging to CO1 and 2 sub questions belonging to CO2. In this case, the items belonging to the choice are all identical but they need not be like that. For example, if you look at the questions which are thus CO4, you can see that 3A has 6 marks at understand level, 7 marks at apply level and 7 marks at apply level, making a total of 6 plus 7 plus 7, 20 marks.

But it is choice item has 5 marks at understand level, 8 marks at apply level and 7 marks at apply level. So, 5 plus 8 plus 7, again 20 marks. There can be minor variations in the choice items but broadly, they are at the same cognitive levels and similar difficulty levels. Once such a structure is determined by the Institute or by the university, we can work out the required number of questions and based on that, we can figure out what should be the minimum size of the item bank.

Consider CO5 and take choice into account. So, if you see CO5 here we can see that in the 4A, question 4A, there is a 4 mark question, again 8 mark question, again 8 mark question. In the choice again, 4 mark question, 8 mark question and 8 mark question. Thus for CO5, we need taking choice into account, 4 questions at apply level each for 8 marks and 2 questions at understand level each for 4 marks.

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Items Required for the Item Banks for SEE

Example: Consider CO5 and take "choice" in to account.
Required questions:
- 4 questions, each for 8 marks, at "Apply" level
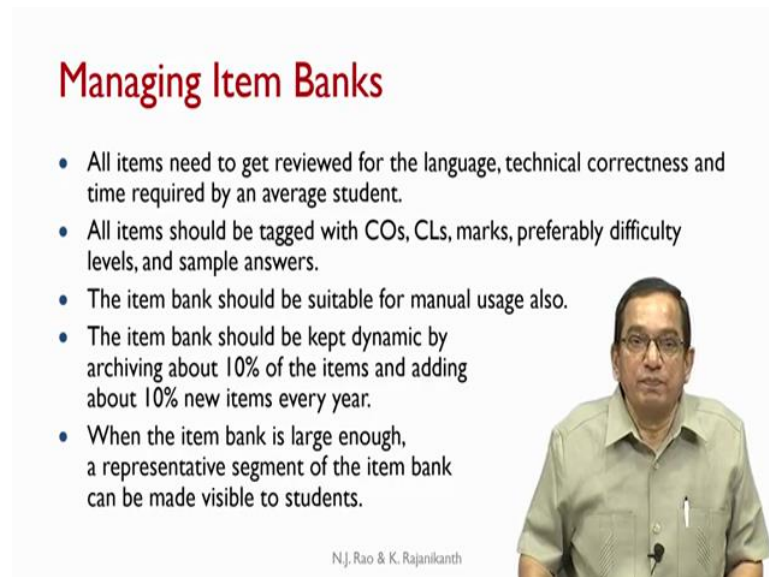- 2 questions, each for 4 marks, at "Understand" level

Item Bank must have:
- 5 * 4 = 20 questions, each for 8 marks, at "Apply" level
- 5 * 2 = 10 questions, each for 4 marks, at "Understand" level

Similar considerations apply to the other COs also.

That is what is shown here. 4 questions, each for 8 marks at apply level, 2 questions, each for 4 marks at understand level. Thus item bank must have, 5 into 4, 20 questions, each for 8

marks at apply level, 5 into 2, 10 questions, each for 4 marks at understand level. All these are related to CO5 only. Similar considerations apply to other COs also. Again, the process looks somewhat tedious, but the problems occur only during the creation of the item bank for the very first time.

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Managing Item Banks

- All items need to get reviewed for the language, technical correctness and time required by an average student.
- All items should be tagged with COs, CLs, marks, preferably difficulty levels, and sample answers.
- The item bank should be suitable for manual usage also.
- The item bank should be kept dynamic by archiving about 10% of the items and adding about 10% new items every year.
- When the item bank is large enough, a representative segment of the item bank can be made visible to students.

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Subsequently, managing the item bank is much simpler. Once we create an item bank, then subsequently, the maintenance of the item bank would be a much simpler activity. The initial effort is worth its while because this allows us to create assessment instruments of uniform quality for CIE as well as for SEE. All items need to get reviewed for the language, technical correctness and time required by an average student.

This is essential because we are using the item bank to compose assessment instruments of good quality. All items should be tagged with COs, cognitive levels, marks, preferably difficulty level, and sample answers also must be provided. The tags are essential in order to pick up the required items to compose a specific assessment instrument.
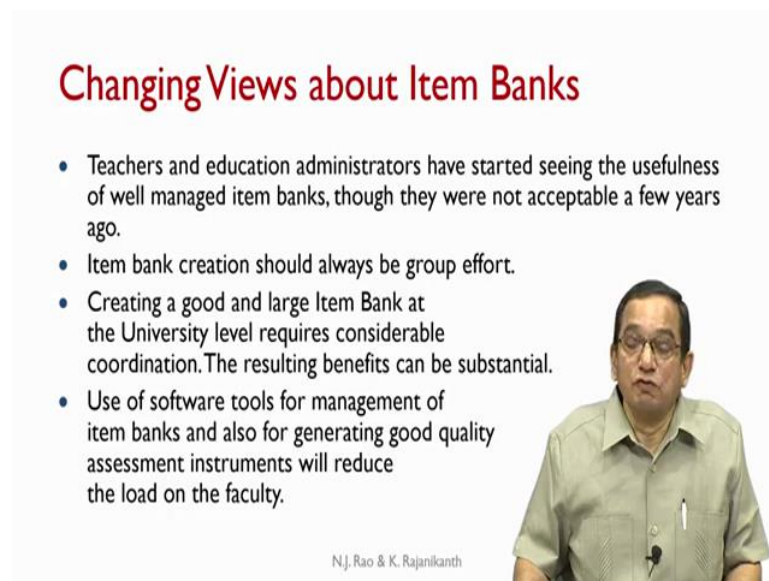
A tool can make use all of the stacks to automatically compose an assessment instrument. The item bank should be suitable for manual usage also. The item bank should be kept dynamic by archiving about 10% of the items and adding about 10% new items every year. Otherwise, the item bank becomes stale and probably it loses the ability to help the faculty in composing quality instruments.

So, about 10% of the items can be archived and 10% new items can be added every year. The items which are being archived can be brought back into the item bank after 3 4 years. So, the

item bank is kept dynamic and when the item bank grows to a size that is reasonably large, representative segment of the item bank can be made visible to the students also.

We can expose about 10 to 15 percent of the items in the item bank to the students also. They get to know the type of assessment items which are possible. Because the item bank is fairly large in size, such an exposing of the part of the item bank to the students does not dilute the quality of the assessment.

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Changing Views about Item Banks

- Teachers and education administrators have started seeing the usefulness of well managed item banks, though they were not acceptable a few years ago.
- Item bank creation should always be group effort.
- Creating a good and large Item Bank at the University level requires considerable coordination. The resulting benefits can be substantial.
- Use of software tools for management of item banks and also for generating good quality assessment instruments will reduce the load on the faculty.
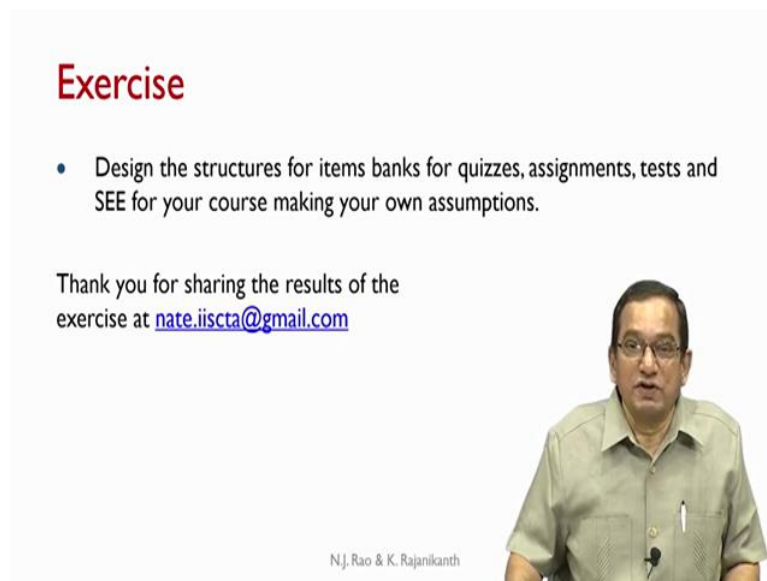
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Now, the views regarding the item banks have been changing over time. Teachers and educational administrators have started seeing the usefulness of well managed item banks though, the item banks were not acceptable a few years ago. Item bank creation should always be a group effort. Creating a good and large item bank at the university level requires considerable coordination.

So, the university has to make special efforts if it has to create an item bank, which is large enough to be used for the composing of SEE instruments. But the resulting benefits can be substantial, particularly for tier 2 institutes as the question paper is composed by the university people and it affects the results to a great extent because a large number of tier 2 institutes are affiliated to university. So, the benefits of a good data bank can be substantial. Use of software tools for management of item banks, and also for generating good quality assessment instruments will reduce the load on the faculty.

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Design the structures for the item banks, for quizzes, assignments, tests and SEE for your course, making your own assumptions. And thank you for sharing the results of the exercise at nate.iiscta@gmail.com.

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In the next unit, we will understand the processes of development phase. With this unit, we have completed the design phase and in the next unit we will start with the development phase. Thank you and we will meet with the next unit. Thank you.