AICTE Exam Reforms Guidelines

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Outline

- Introduction
- Assessment strategy for Outcome Based Education
- Improving Structure & Quality of Assessments
- Assessing Higher Order abilities & Professional Skills
- APPENDIX-A-Competencies and Performance Indicators (PIs)
- APPENDIX-B-Sample questions for Bloom's Taxonomy levels
- APPENDIX-C-Model Question Papers
- APPENDIX-D-Sample Scoring Rubrics

Introduction

- Future engineering graduate not only need to be knowledgeable in his/her discipline, but also needs a new set of **soft, professional skills and competencies**
- Essential changes in engineering education in terms of
  - **What to teach (content)**
  - **How to teach (knowledge delivery)**
  - **How to assess (student learning).**
- The digital initiatives of MHRD and AICTE have made available a very large number of Massive **MOOCs through SWAYAM**, that can help the colleges and teachers adopt innovative methodologies in the delivery of course.
- **Outcome based education-** a performance-based approach has emerged as a major reform model in the global engineering education scenario

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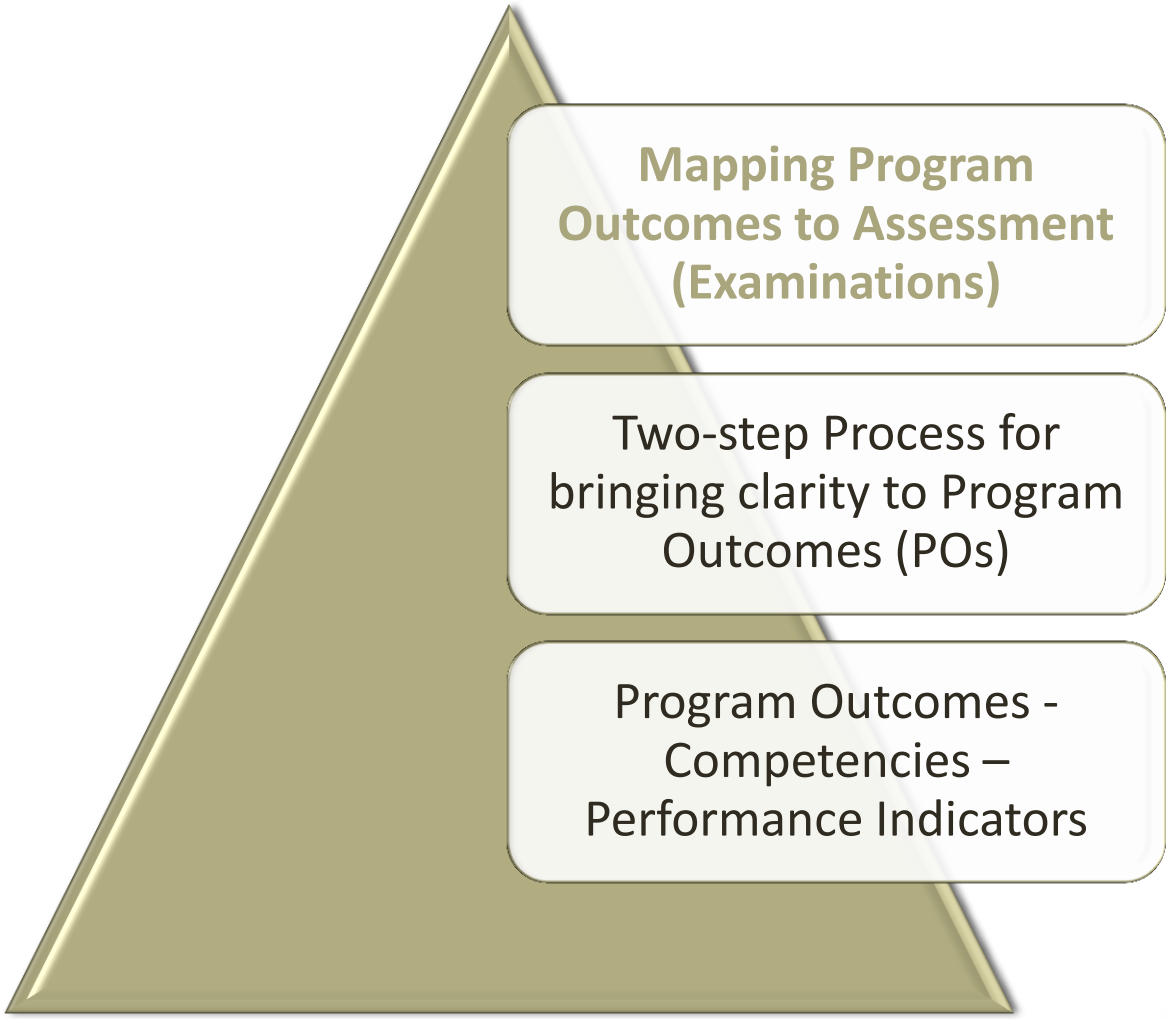
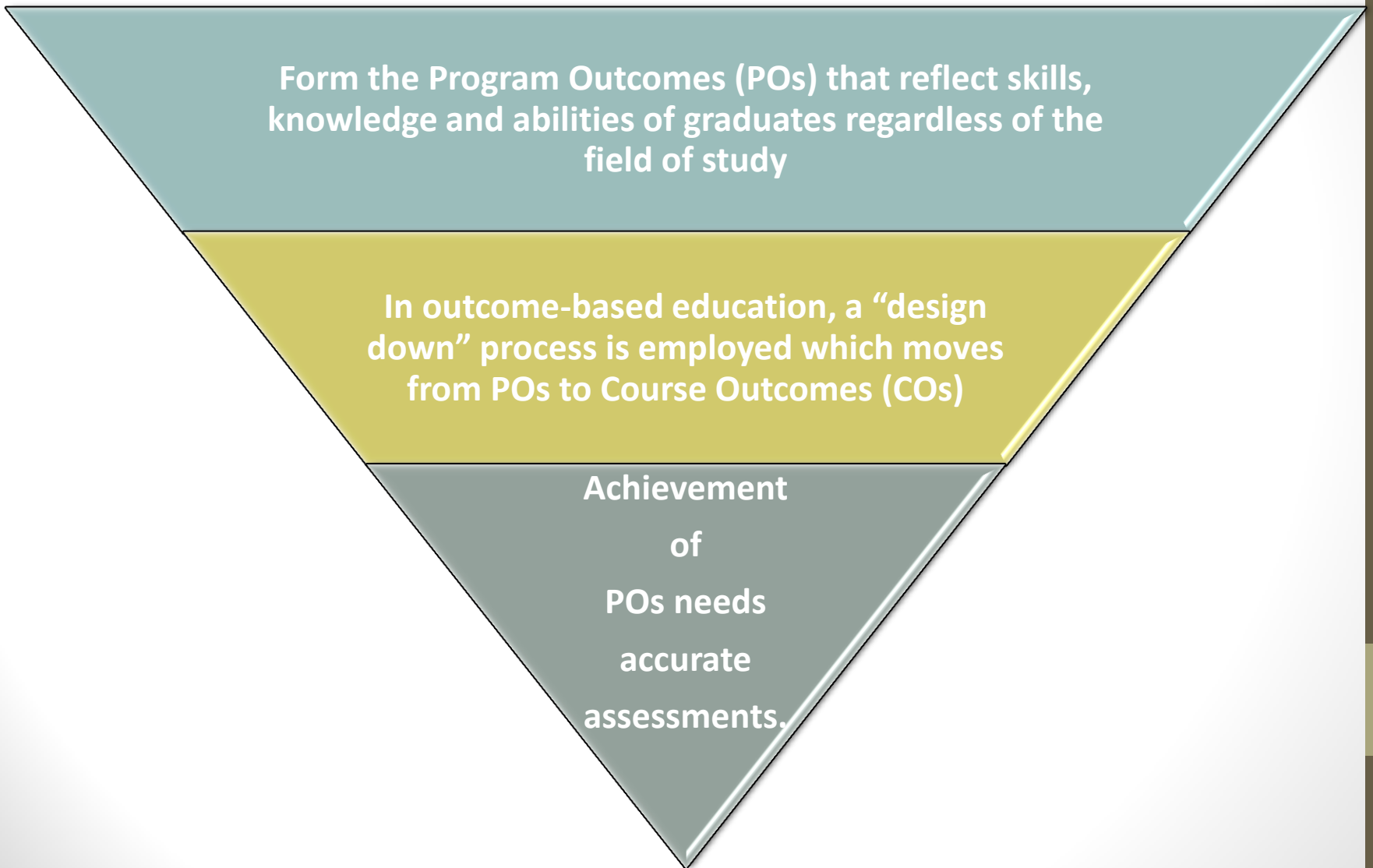
Assessment strategy for Outcome Based Education

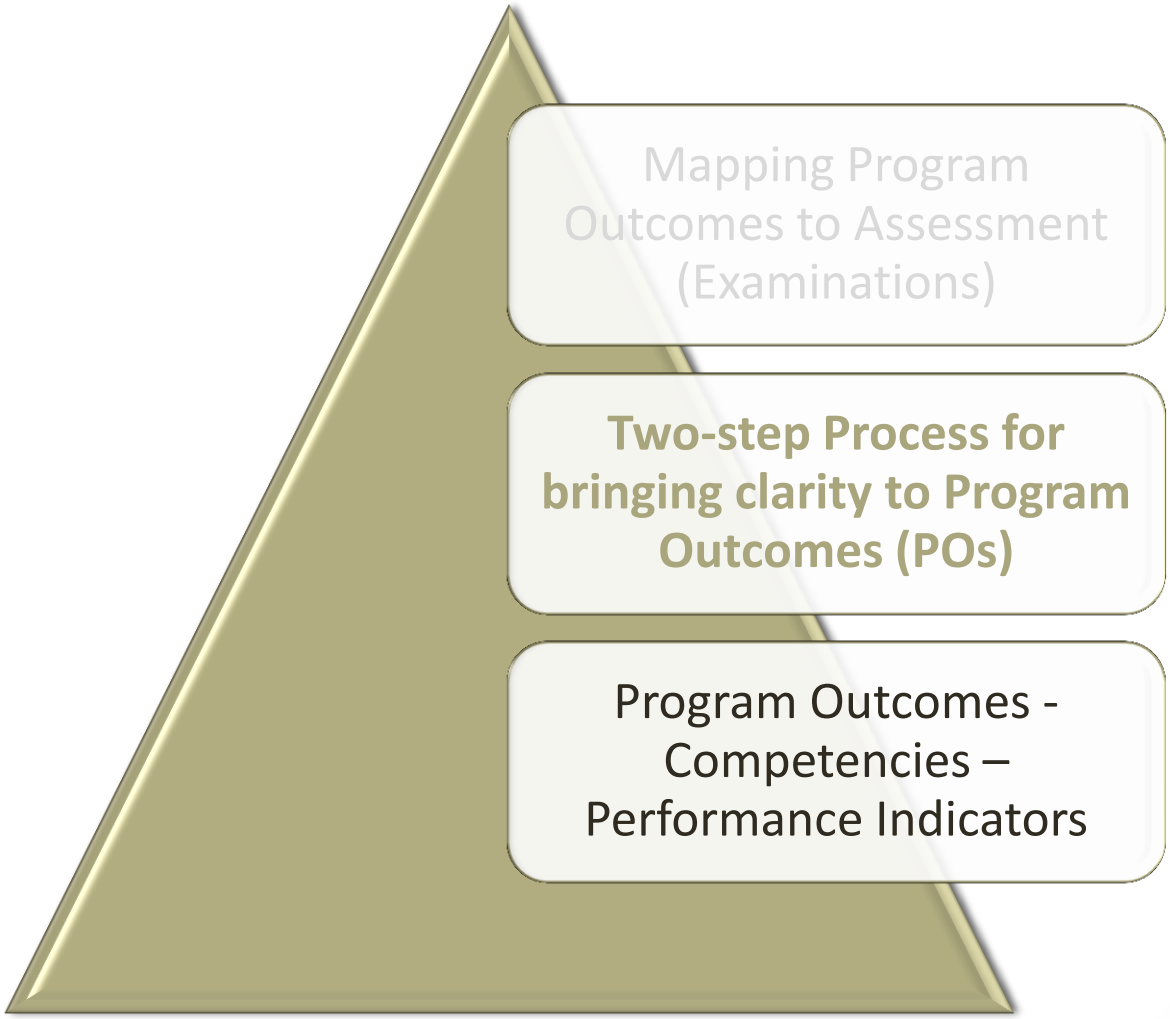


Assessment strategy for Outcome Based Education-

Mapping Program Outcomes to Assessment (Examinations)



Assessment strategy for Outcome Based Education



Assessment strategy for Outcome Based Education-

Two-step Process for bringing clarity to Program Outcomes (POs)

- 1. **Identify *Competencies to be attained***: **For each PO define *competencies*** -different abilities implied by program outcome statement that would generally require different assessment measures.

- 2. **Define *Performance Indicators***: **For each of the *competencies* identified, define Performance Indicators (PIs)** that are explicit statements of expectations of the student learning.

Assessment strategy for Outcome Based Education-

Two-step Process for bringing clarity to Program Outcomes (POs)

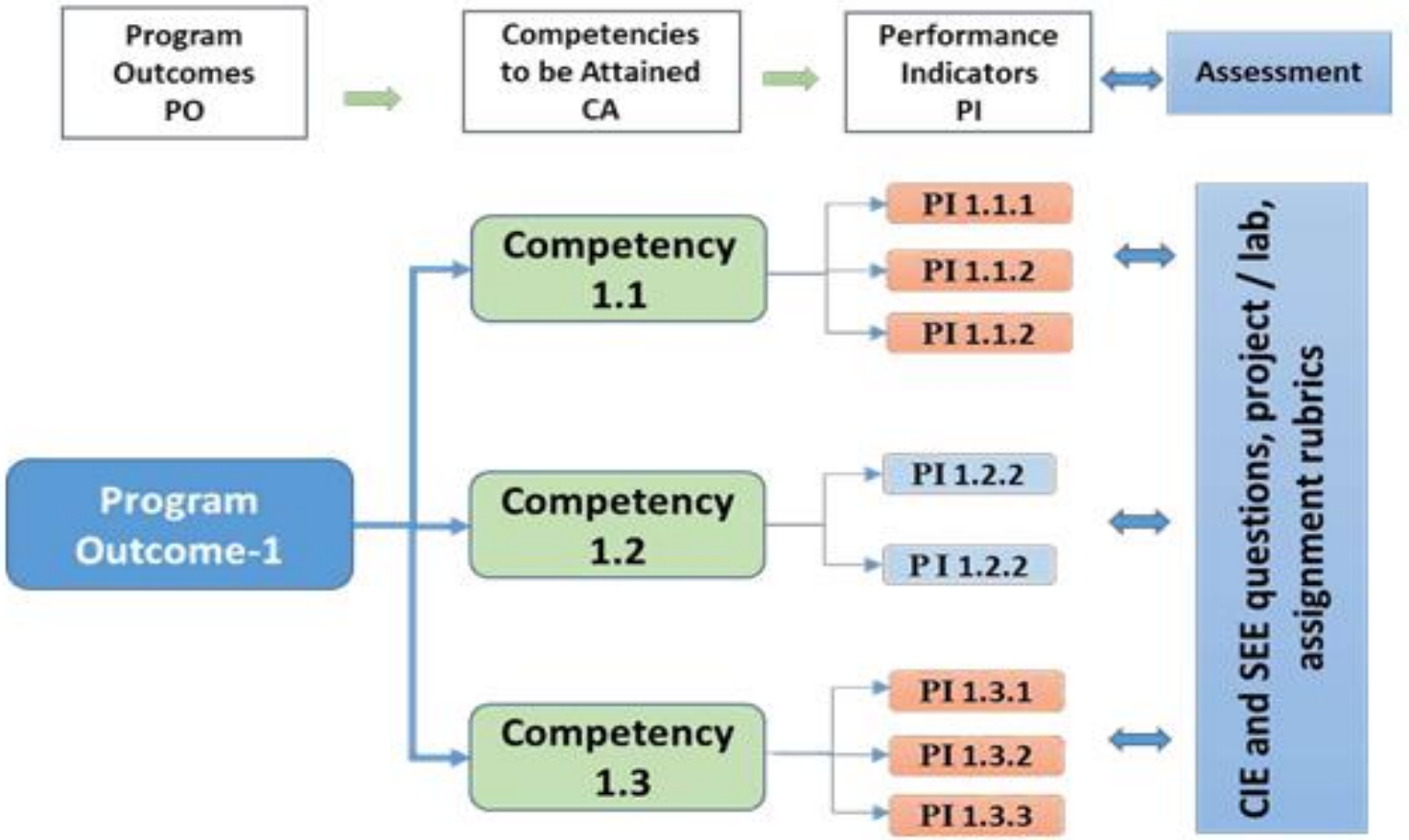


Fig.1 Connecting POs to Assessment

Assessment strategy for Outcome Based Education

Assessment strategy for Outcome Based Education-
Program Outcomes -Competencies – Performance Indicators

Some Examples of Suggestive list of competencies and PI for Computer Science

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

Competency	Indicators	
1.2 Demonstrate competence in mathematical modelling	1.2.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
	1.2.2	Apply the concepts of probability, statistics and queuing theory in modeling of computer based system, data and network protocols.
1.5 Demonstrate competence in basic sciences	1.5.1	Apply laws of natural science to an engineering problem
1.6 Demonstrate competence in engineering fundamentals	1.6.1	Apply engineering fundamentals
1.7 Demonstrate competence in specialized engineering knowledge to the program	1.7.1	Apply theory and principles of computer science engineering to solve an engineering problem

Assessment strategy for Outcome Based Education-
Program Outcomes -Competencies – Performance Indicators

Some Examples of Suggestive list of competencies and PI for Computer Science

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	
Competency	**Indicators**
5.4 Demonstrate an ability to identify / create modern engineering tools, techniques and resources	5.4.1 Identify modern engineering tools, techniques and resources for engineering activities 5.4.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.5 Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.5.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. 5.5.2 Demonstrate proficiency in using discipline specific tools
5.6 Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.6.1 Discuss limitations and validate tools, techniques and resources 5.6.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

Assessment strategy for Outcome Based Education-
Program Outcomes -Competencies – Performance Indicators

Some Examples of Suggestive list of competencies and PI for Computer Science

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	
Competency	**Indicators**
6.1 Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
6.2 Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

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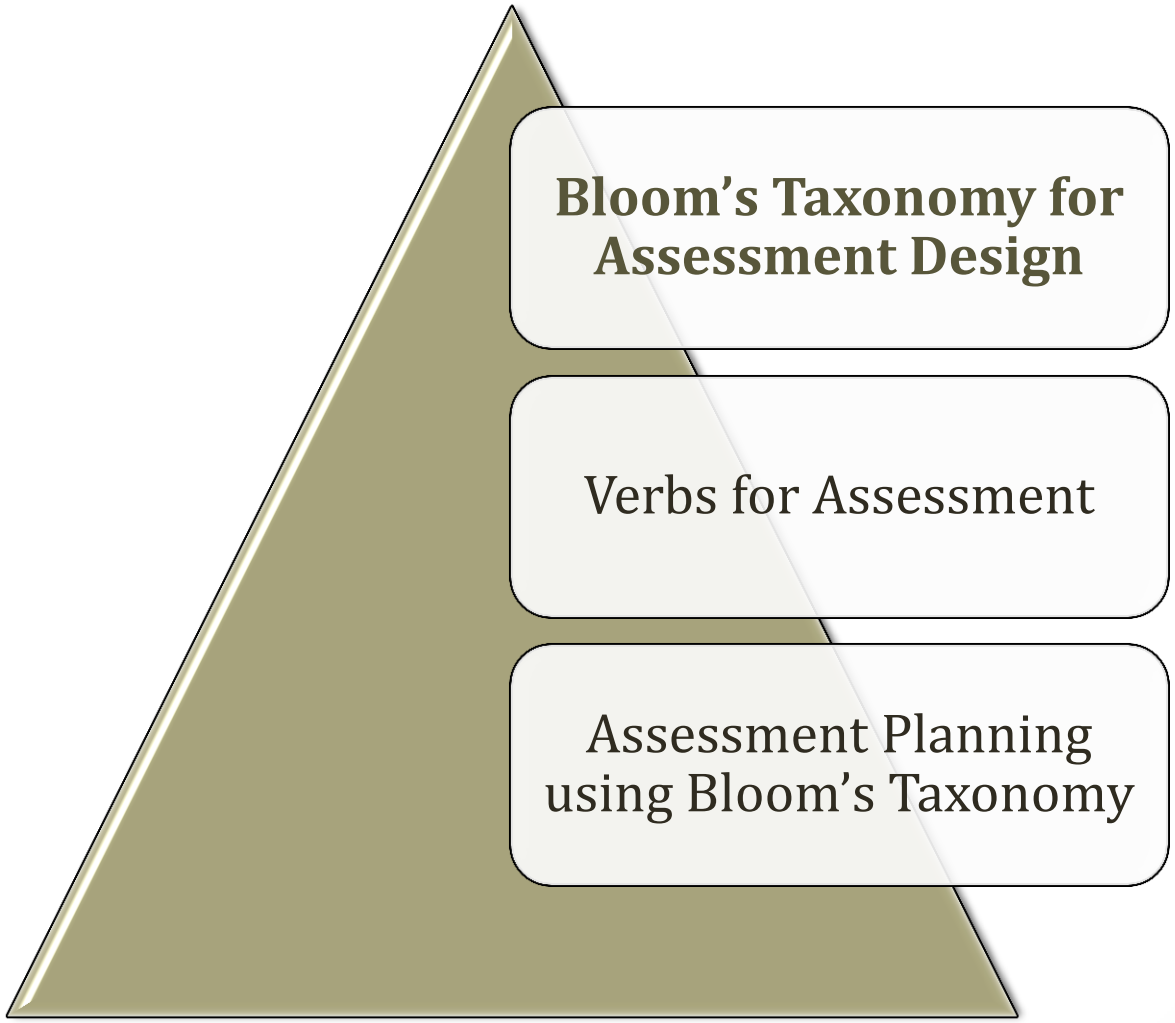
Improving Structure & Quality of Assessments



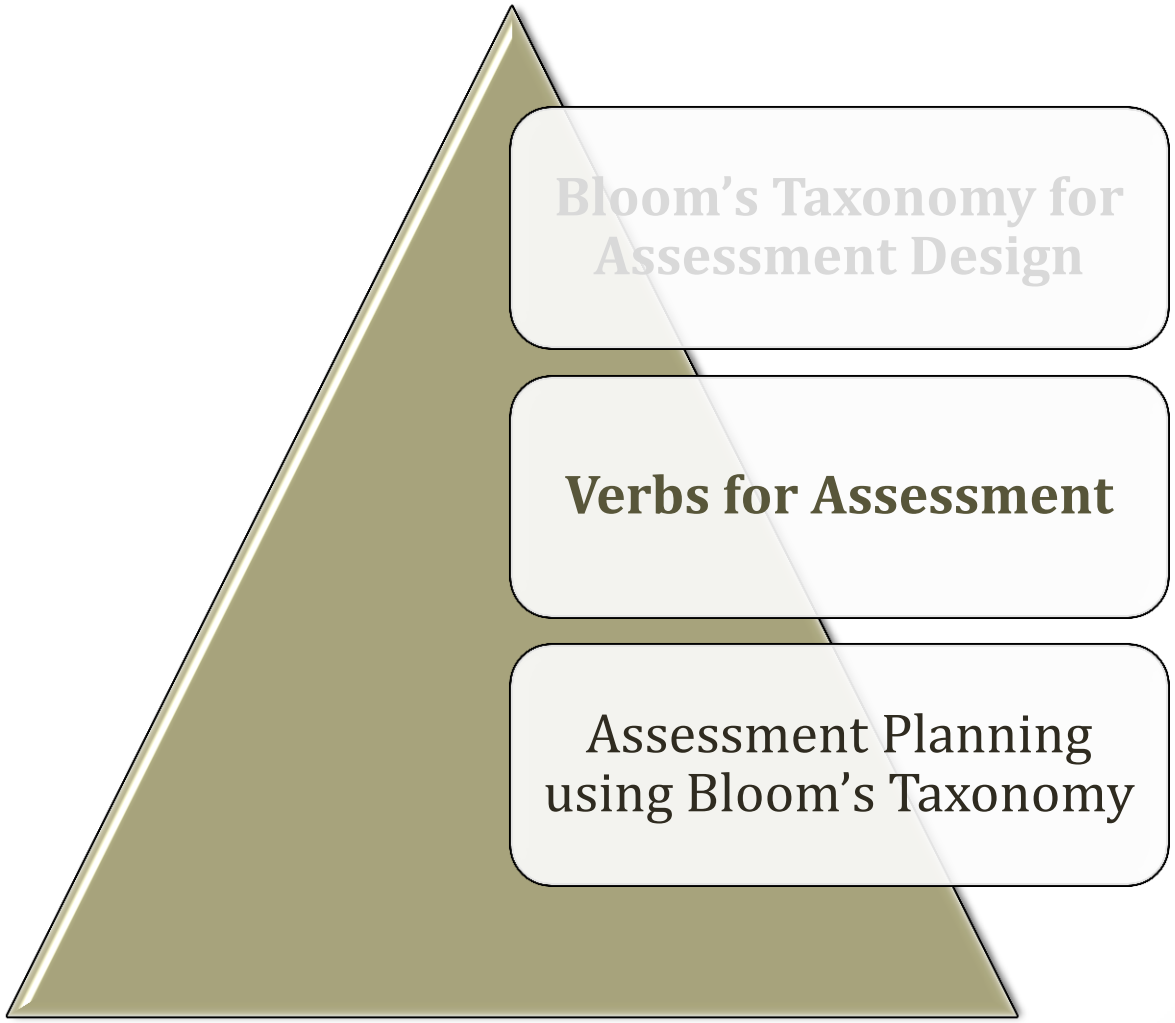
Improving Structure & Quality of Assessments- Bloom's Taxonomy for Assessment Design

Level	Descriptor	Level of attainment
1	Remembering	Recalling from memory of previously learned material
2	Understanding	Explaining ideas or concepts
3	Applying	Using information in another familiar situation
4	Analysing	Breaking information into part to explore understandings and relationships
5	Evaluating	Justifying a decision or course of action
6	Creating	Generating new ideas, products or new ways of viewing things

Improving Structure & Quality of Assessments-
Bloom's Taxonomy for Assessment Design

Fig. 2, Revised Bloom's Taxonomy

Improving Structure & Quality of Assessments



Improving Structure & Quality of Assessments- Action Verbs for Assessment

Level	Skill Demonstrated	Question Ques / Verbs for tests
1. Remember	• Ability to recall of information like, facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • ability to recall methodology and procedures, abstractions, principles, and theories in the field • knowledge of dates, events, places • mastery of subject matter	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where, etc.
2. Understand	• understanding information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss

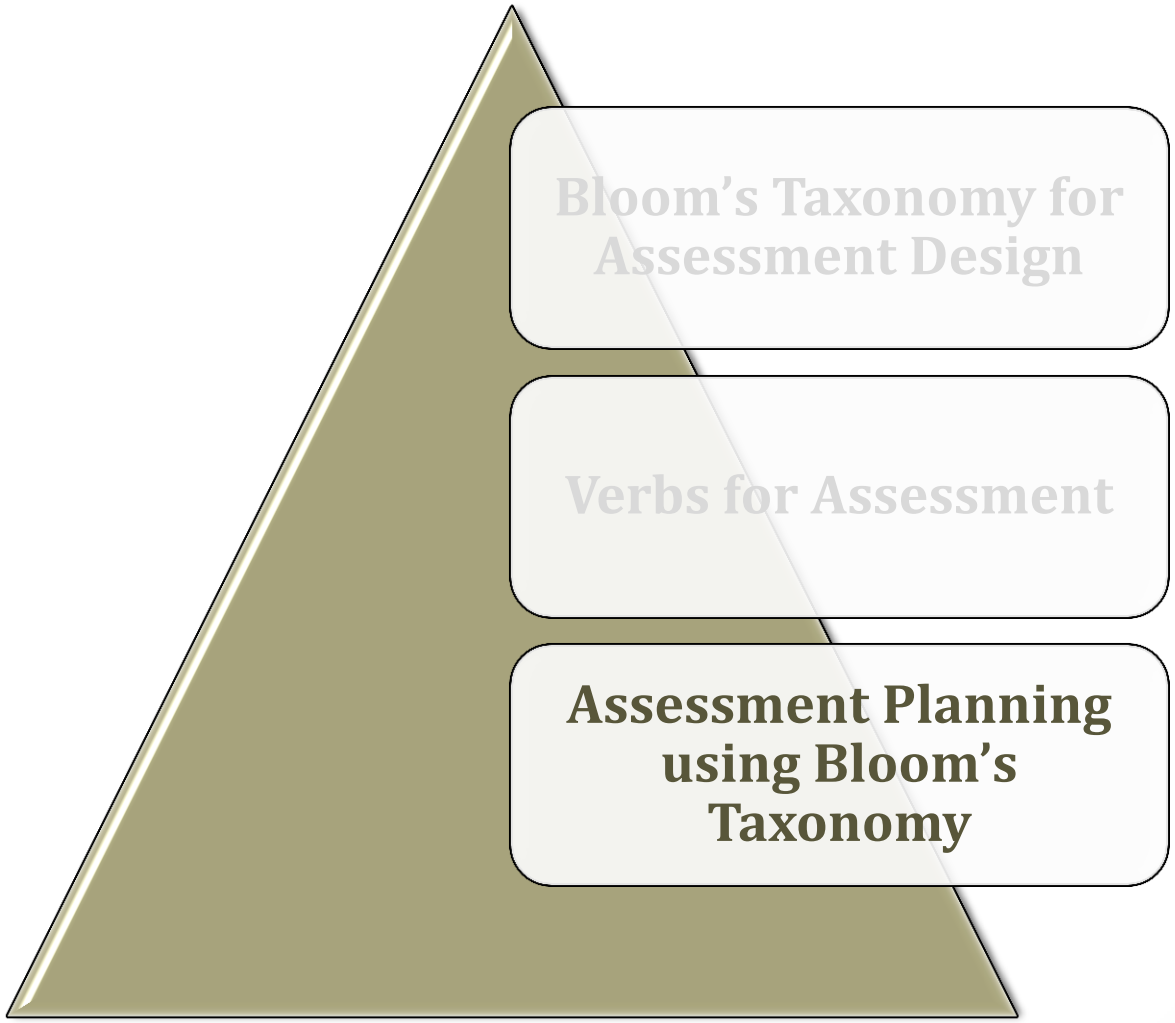
Improving Structure & Quality of Assessments- Action Verbs for Assessment

Level	Skill Demonstrated	Question Ques / Verbs for tests
3. Apply	• use information • use methods, concepts, laws, theories in new situations • solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyse	• break down a complex problem into parts. Identify the relationships and interaction between the different parts of complex • problem. identify the missing information, sometimes the redundant information and the contradictory information, if any.	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select

Improving Structure & Quality of Assessments- Action Verbs for Assessment

Level	Skill Demonstrated	Question Ques / Verbs for tests
5. Evaluate	• compare and discriminate between ideas • assess value of theories, presentations make • choices based on reasoned argument verify value of evidence recognize subjectivity use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	• use old ideas to create new ones • combine parts to make (new) whole, • generalize from given facts relate knowledge from several areas predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

Improving Structure & Quality of Assessments



Improving Structure & Quality of Assessments- Assessment Planning using Bloom's Taxonomy

- While using Bloom's taxonomy framework in planning and designing of assessment of student learning, following points need to be considered:

  - Normally the **first three learning levels**; remembering, understanding and applying and to some extent fourth level analysing are **assessed in the Continuous Internal Evaluation (CIE) and semester End Examinations (SEE)**, where students are given limited amount of time**.**

  - And **last three learning levels** abilities; analysis, evaluation and creation can be assessed in extended course works or in variety of student works like **course projects, mini / minor projects, internship experience and final year projects.**

Improving Structure & Quality of Assessments-
Assessment Planning using Bloom's Taxonomy

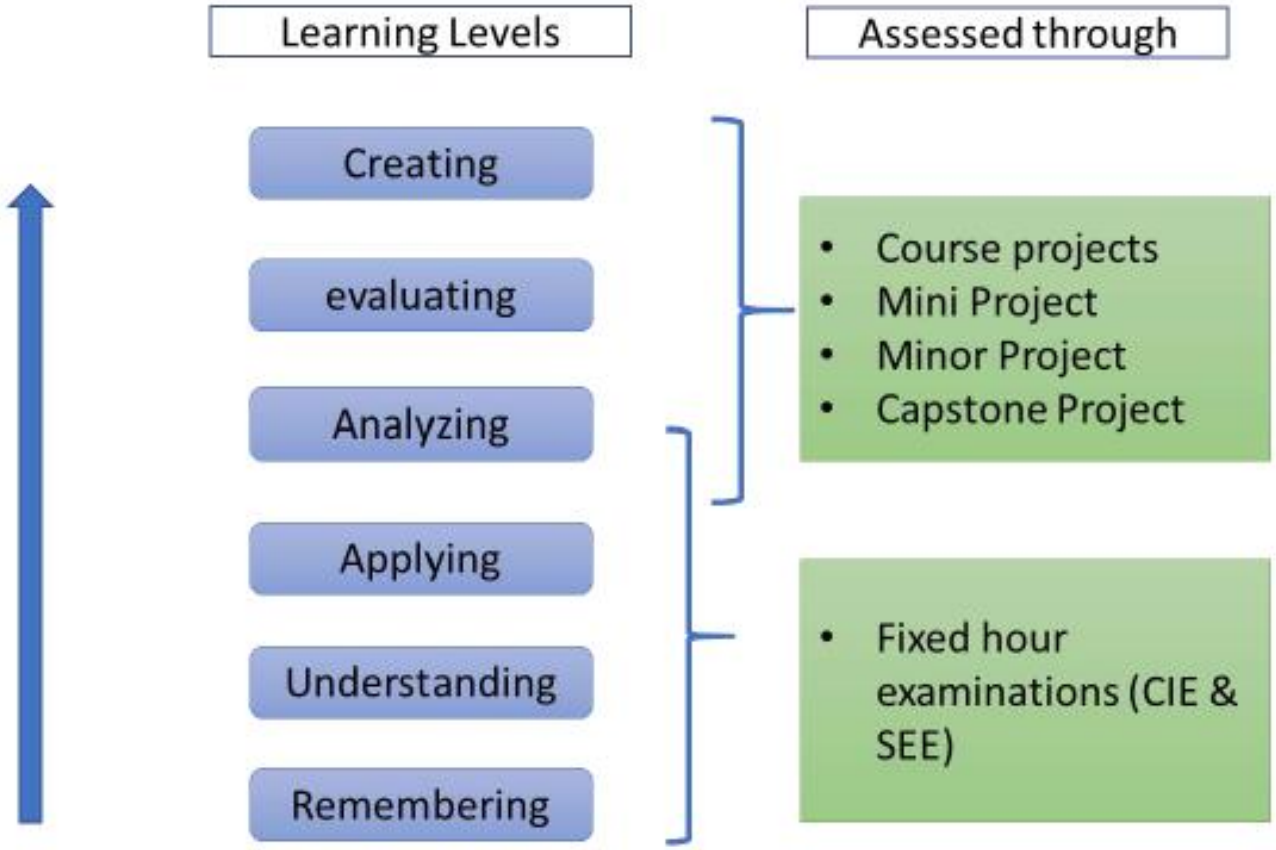


Fig. 3 Assessment methods for different Bloom's cognitive levels

Improving Structure & Quality of Assessments- Assessment Planning using Bloom's Taxonomy

- Before adopting this framework for reforms in examination system of a University/Institution, it is worthwhile to study the present pattern of assessment in each of the course in the program to gain insight about:

  a) Alignment of assessment questions with course learning outcomes

  b) Whether all the learning outcomes are tested; sometimes some learning outcomes are over tested at the expense of others which may be not tested at all.

  c) Overall weightage in the assessment, to each of the Bloom's learning levels

  d) Assessment methods used to adequately assess the content and desired learning outcomes

Improving Structure & Quality of Assessments- Assessment Planning using Bloom's Taxonomy

- Examination paper must consist of various difficulty levels to accommodate the different capabilities of students.
- Bloom's taxonomy framework helps the faculty to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception.
- It is recommended that at institution/ University level, upper limit need to be arrived for lower order skills (for example,no more than 40% weightage for knowledge-oriented questions).
- **Examples of typical questions for each of the Bloom's cognitive level are given in Appendix-B Model question Papers are given in Appendix- C**

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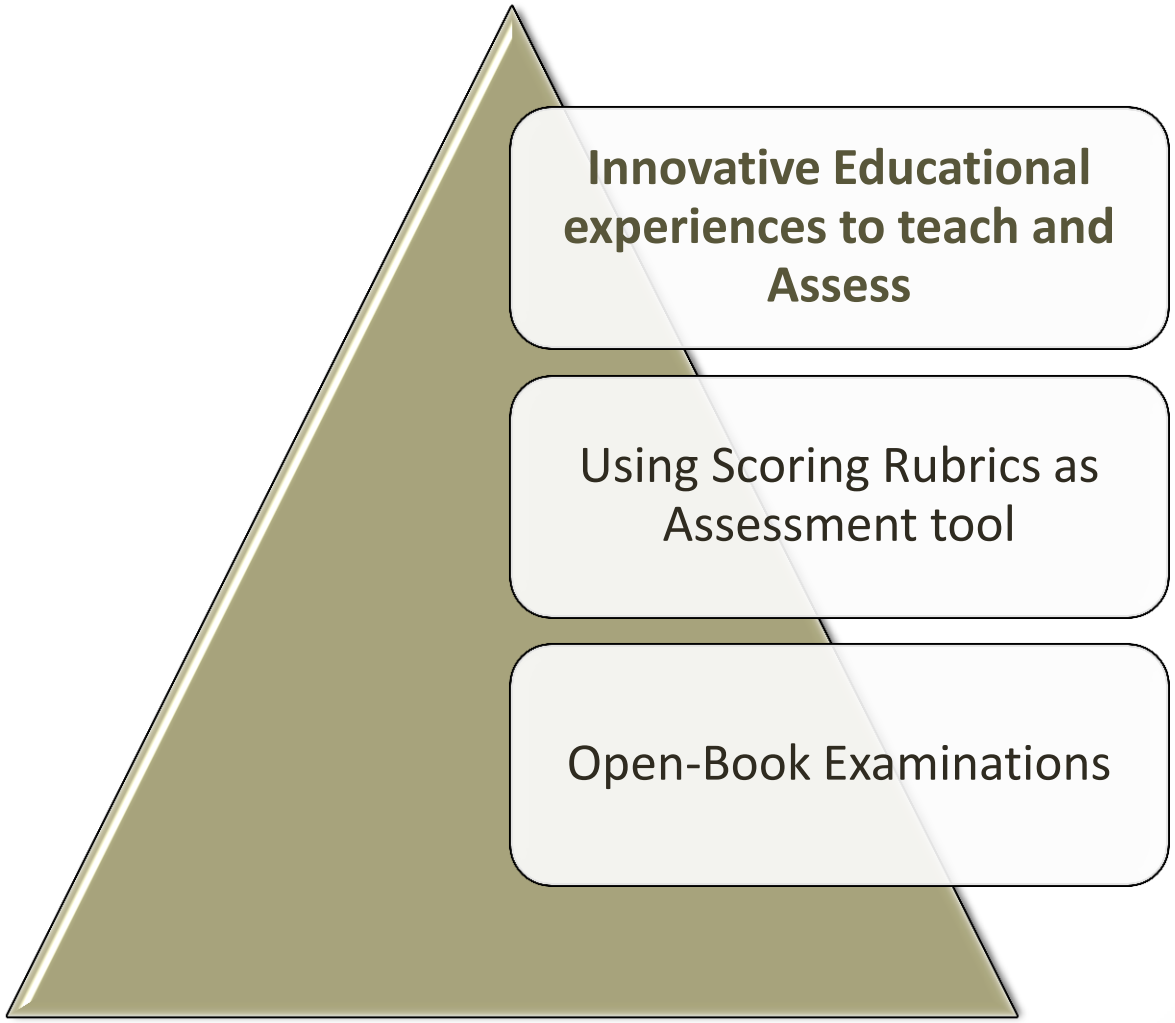
Assessing Higher Order abilities & Professional Skills



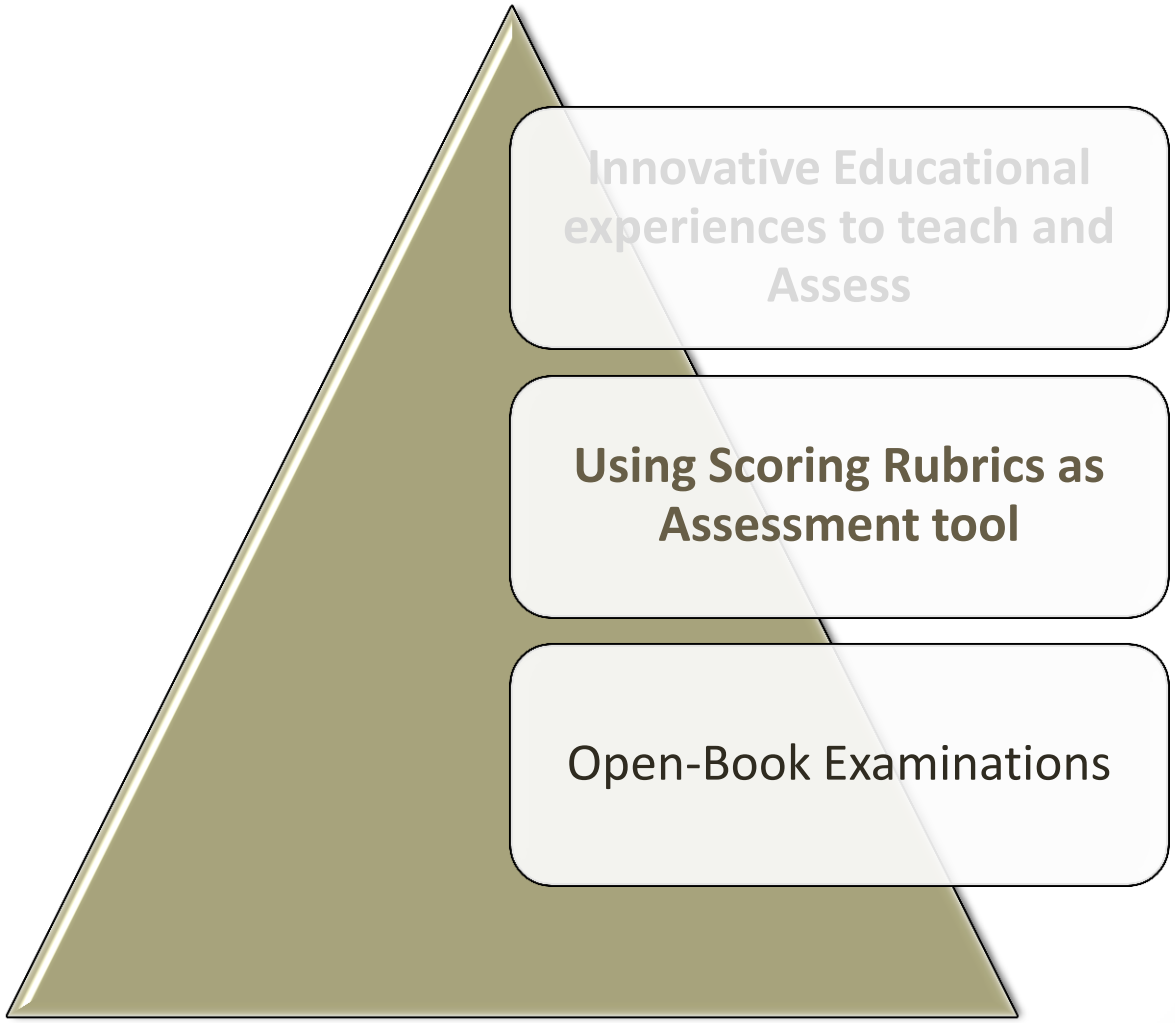
Assessing Higher Order abilities & Professional Skills

Innovative Educational experiences to teach and Assess

- Following are the few educational experiences that are recommended to teach and assess professional outcomes and higher order cognitive abilities:

  - Course projects
  - Open-ended experiments in laboratories
  - Project-based learning modules
  - MOOCS
  - Co-Curricular experiences
  - Mini / Minor projects
  - Final year projects
  - Internship experiences
  - E-portfolios of student works

Assessing Higher Order abilities & Professional Skills



Assessing Higher Order abilities & Professional Skills

Using Scoring Rubrics as Assessment tool

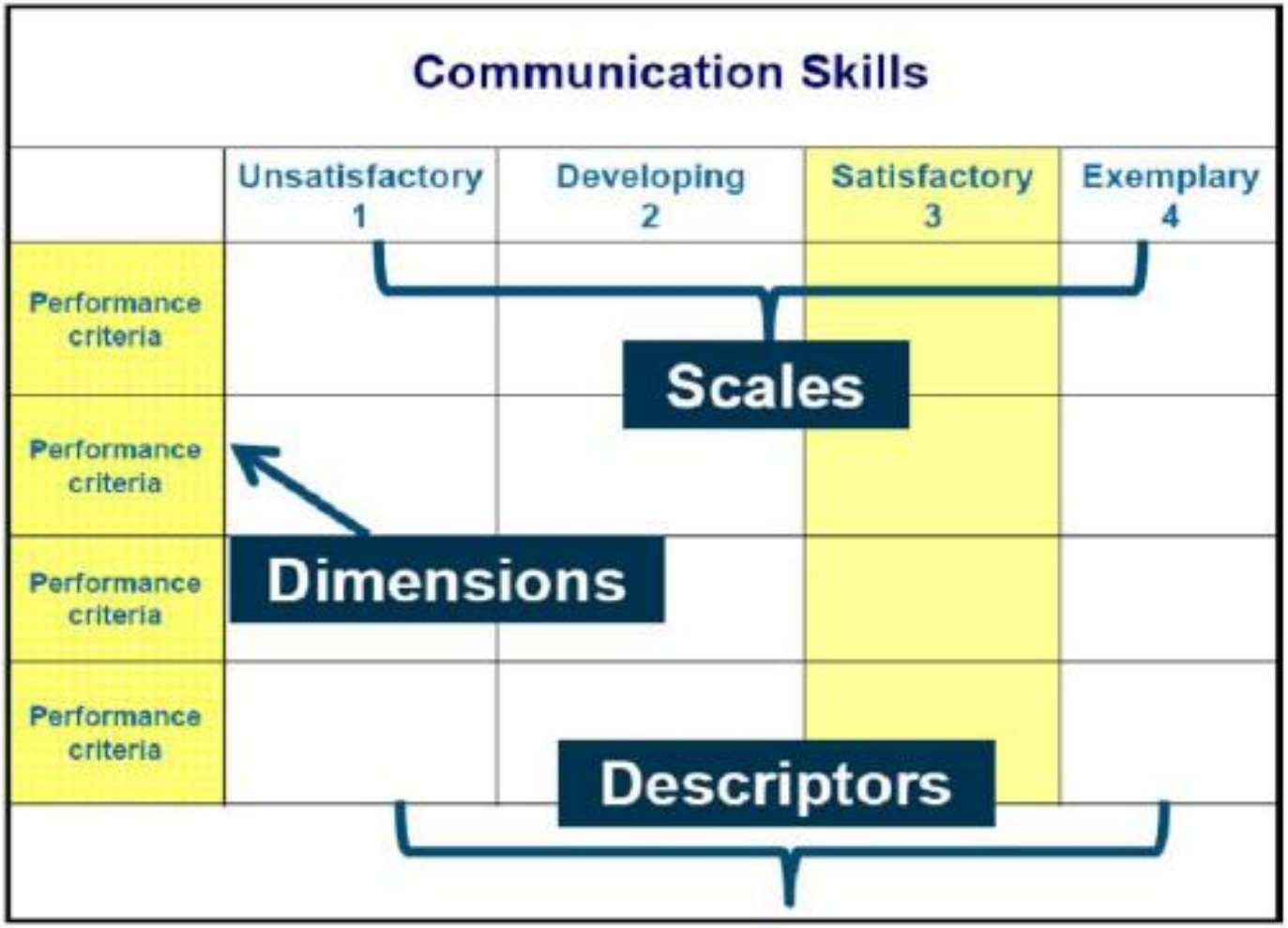
- **Rubrics** provide a powerful tool for assessment and grading of student work.

- There are **three components within rubrics** namely
  - (i) **criteria / performance Indicator**: the aspects of performance that will be assessed
  - (ii) **descriptors:** characteristics that are associated with each dimension
  - (iii) **scale/level of performance**: a rating scale that defines students' level of mastery within each criterion.

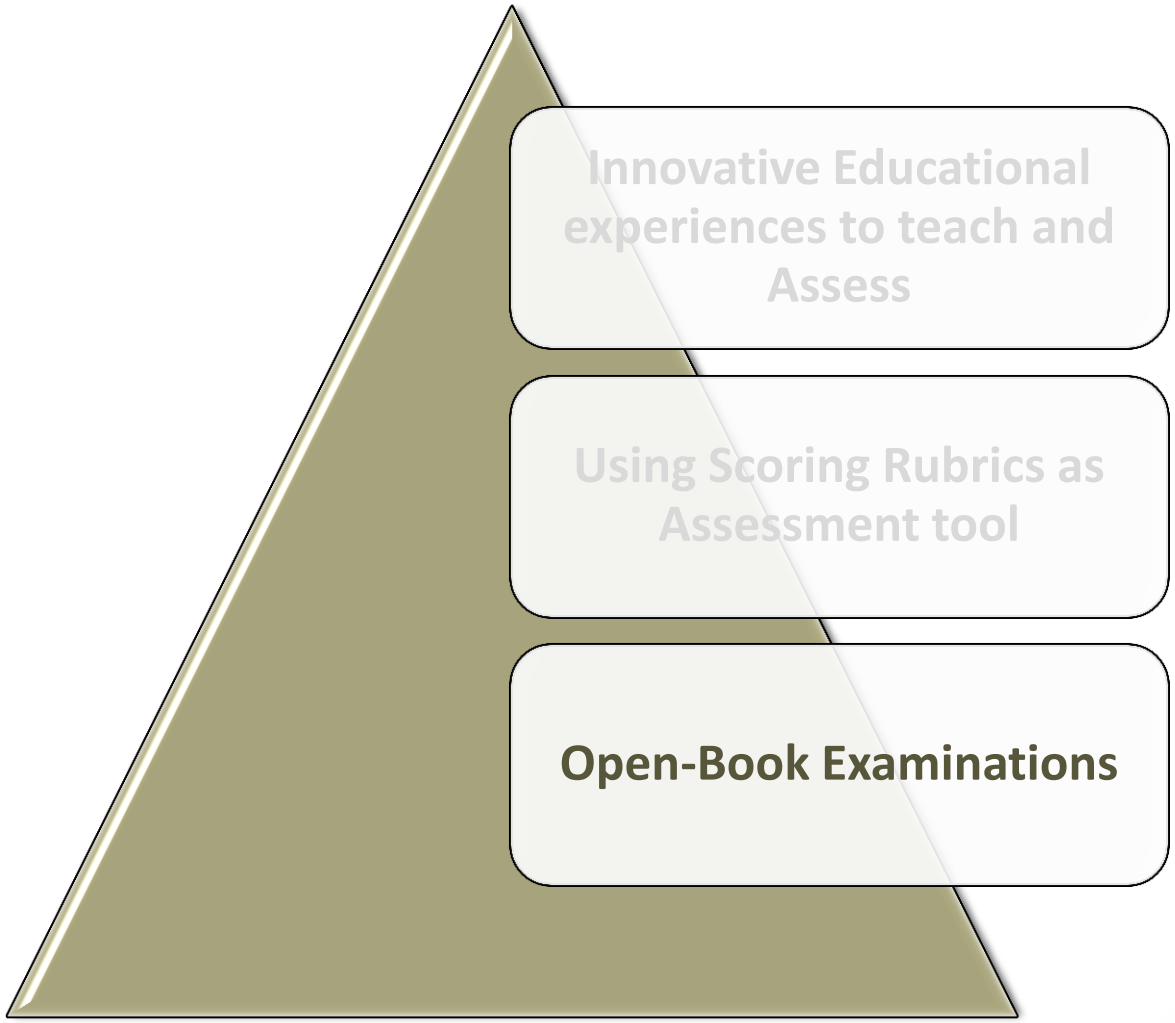
Assessing Higher Order abilities & Professional Skills

Using Scoring Rubrics as Assessment tool

Examples of Rubrics (Accessed from Rogers (2010)



Assessing Higher Order abilities & Professional Skills



Assessing Higher Order abilities & Professional Skills
Open-Book Examinations

- Open book examination allows students to refer to either class notes, textbooks, or other approved material while answering questions.
- They are particularly **useful** if you want to test skills in **application, analysis and evaluation i.e. higher levels of Bloom's taxonomy.**

- **Advantages of open-book examinations**
  - 1. Less demanding on memory and hence less stressful
  - 2. Questions can emphasise more on problem solving, application of knowledge and higher order thinking
  - 3. Assessment questions can reflect real life situations that requires comprehension, information retrieval and synthesising skills of the students to solve.

Assessing Higher Order abilities & Professional Skills

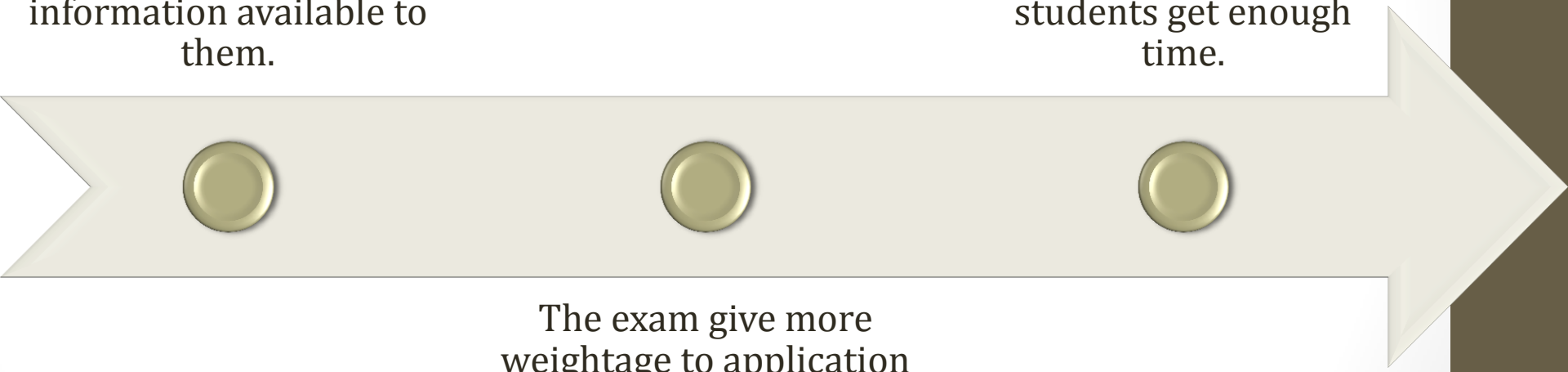
Open-Book Examinations

Designing a good Open Book Examination

Set questions that require students to do things with the information available to them.

The exam give more weightage to application of knowledge, critical thinking and use of resources for solving real complex engineering problems.

As the nature of questions is complex, it is to be ensured that the students get enough time.



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APPENDIX-A-Competencies and Performance Indicators (PIs)

- Refer Slide number 11 to 13

- (For All PO's kindly refer below link)

https://www.aicte-india.org/sites/default /files/ ExaminationReforms.pdf

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Sample questions for Bloom's Taxonomy level **1. Remember**

- State Ohm's law
- List the components of A/D converter
- List the arithmetic operators in increasing order of precedence.
- Define the purpose of a constructor.
- Define the terms: Sensible heat, Latent heat and Total heat of evaporation
- Describe the process of galvanisation and tinning
- Write truth table and symbol of AND, OR, NOT, XNOR gates
- What is the difference between declaration and definition of a variable/function?
- What is the use of local variables?
- What is a pointer on pointer?

Sample questions for Bloom's Taxonomy level **2. Understand**

- Explain the importance of sustainability in Engineering design
- Explain the terms; Particle, Rigid body and Deformable body giving two examples for each.
- What is the difference between including the header file within angular braces < > and double quotes " "?
- What is the difference between actual and formal parameters?
- Explain the different ways of passing parameters to the functions.
- Explain the use of comma operator (,).
- Differentiate between entry and exit controlled loops.
- How is an Array different from Linked List?

Sample questions for Bloom's Taxonomy level **3. Apply**

1. A single array A[1..MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables *top1* and *top2* (*topl*< *top2*) point to the location of the topmost element in each of the stacks. What is the condition for "stack full", if the space is to be used efficiently.
2. Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

3. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation lookaside buffer (TLB) which can hold a total of 128-page table entries and is 4-way set associative. What is the minimum size of the TLB tag?

Sample questions for Bloom's Taxonomy level **4. Analyze**

1. While writing a C code, the problem faced by the programmers is to find if the parenthesis is balanced or not. Write an algorithm to check if the parenthesis in C code are balanced.Initially your code should work for balanced { and } braces.

2. Swapping of the data in a linked list can be performed by swapping the contents in the linked list. Can the contents of a linked list be swapped without actually swapping the data?

3. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.

4. Bob wrote a program using functions to find sum of two numbers whereas Alex wrote the statements to find the sum of two numbers in the main() function only. Which of the two methods is efficient in execution and why?

Sample questions for Bloom's Taxonomy level **5. Evaluate & 6. Create**

- **Both higher order cognitive skills 'Evaluate' and 'Create' are difficult to assess in time-limited examinations. These need to be assessed in variety of student works like projects, open ended problem-solving exercises etc. Typical examples of problem statements or need statements which need higher order abilities to solve are given below**

1. Design a system to assist the driver by using cameras to detect lane markers and pedestrians while the vehicle is in motion.

2. A Biotech industry needs automation for filling its product into 20 ltr bottles. Design a system to meter the flow into the bottles so that each bottle has 20 ltr of the liquid. There will be more than 37 one filling station and the system has to monitor all the filling stations as well as keep count of the total production on a daily basis

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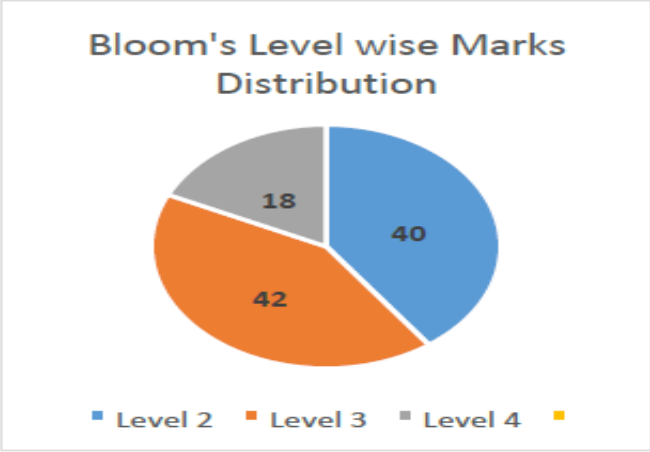
Model Question Papers

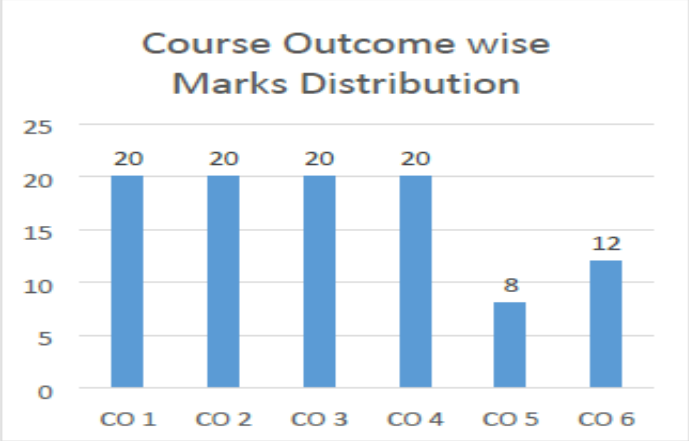
Model Question Paper

Course: Programming for Problem solving (ESC 103)

Maximum Marks :100; Duration: 03 hours

Q.No	Questions	Marks	CO	BL	PI
1(a)	Explain the steps involved in solving a problem using computer.	08	CO1	L2	1.4.1
1(b)	Write an algorithm to find roots of a quadratic equation ax2 + bx +c = 0 reading the values of a, b and c.	12	CO2	L3	1.4.1
2(a)	Compare if-else-if and switch statement giving examples for their relevant use.	08	CO2	L2	1.4.1





BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code

Model Question Papers

Model Question Paper for End Semester Examination Course Name: Programming for Problem Solving

Duration: 3 hrs. ; Max. Marks: 100

Instructions:

a. **Attempt five questions selecting ONE from each section. Question 9 (Section E) is compulsory.**
b. **All the questions carry equal marks.**
c. **Draw neat diagrams wherever applicable.**

Q. No	Question	Marks	BL	CO	PO	PI Code
	Section-A					
1	a. What is an algorithm? Explain the characteristics of an algorithm.	2+6	1,2	2	1	1.4.1
	b. Write an algorithm to find angle between hour and minute hands of a clock at a given time.	7	3	3	1	1.4.1

BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)
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PO – Program Outcomes; PI Code – Performance Indicator Code

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APPENDIX-D-Sample Scoring Rubrics

Rubrics for Communication (written & Oral)

Component	Proficient	Acceptable	Needs Improvements
Written Communication	Report is well organized and clearly written. The underlying logic is clearly articulated and easy to follow. Words are chosen that precisely express the intended meaning and support reader comprehension. Diagrams or analyses enhance and clarify presentation of ideas. Sentences are grammatical and free from spelling errors.	Report is organized and clearly written for the most part. In some areas the logic or flow of ideas is difficult to follow. Words are well chosen with some minor exceptions. Diagrams are consistent with the text. Sentences are mostly grammatical and only a few spelling errors are present but they do not hinder the reader.	Report lacks an overall organization. Reader has to make considerable effort to understand the underlying logic and flow of ideas. Diagrams are absent or inconsistent with the text. Grammatical and spelling errors make it difficult for the reader to interpret the text in places.
Presentation Visual Aids	Slides are error-free and logically present the main components of the process and recommendations. Material is readable and the graphics highlight and support the main ideas.	Slides are error-free and logically present the main components of the process and recommendations. Material is mostly readable and graphics reiterate the main ideas.	Slides contain errors and lack a logical progression. Major aspects of the analysis or recommendations are absent. Diagrams or graphics are absent or confuse the audience.
Oral Presentation	Speakers are audible and fluent on their topic, and do not rely on notes to present or respond. Speakers respond accurately and appropriately to audience questions and comments.	Speakers are mostly audible and fluent on their topic, and require minimal referral to notes. Speakers respond to most questions accurately and appropriately.	Speakers are often inaudible or hesitant, often speaking in incomplete sentences. Speakers rely heavily on notes. Speakers have difficulty responding clearly and accurately to audience questions.
Body Language	Body language, as indicated by appropriate and meaningful gestures (e.g., drawing hands inward to convey contraction, moving arms up to convey lift, etc.) eye contact with audience, and movement, demonstrates a high level of comfort and connection with the audience.	Body language, as indicated by a slight tendency to repetitive and distracting gestures (e.g., tapping a pen, wringing hands, waving arms, clenching fists, etc.) and breaking eye contact with audience, demonstrates a slight discomfort with the audience.	Body language, as indicated by frequent, repetitive and distracting gestures, little or no audience eye-contact, and /or stiff posture and movement, indicate a high degree of discomfort interacting with audience.

References

- https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf