OUTCOME BASED EDUCATION MANUAL

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
A GOVT. AIDED UGC AUTONOMOUS & NAAC ACCREDITED INSTITUTE, AFFILIATED TO R.G.P.V BHOPAL (M.P)

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India, OBE and Accreditation

In response to the need for standardization of education systems and processes, many higher education institutions shifted attention and efforts toward implementing the Outcome-Based Education (henceforth OBE) system. The shift to OBE has been propelled predominantly because it is used as a framework by international and local academic accreditation bodies

Implementation of OBE in higher technical education also started in India. The National Assessment and Accreditation Council (NAAC) and the National Board of Accreditation (NBA) are autonomous bodies for promoting global quality standards for technical education in India. NBA has started accrediting only the programs running with OBE from 2013. The National Board of Accreditation mandates establishing a culture of outcome-based education (OBE) in institutions.

Outcomes-based education as defined by Spady (1994, p. 12) means "clearly focusing and organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experience."

Outcome-based education is a model of education that deviates from the traditional focus on what the institution provides to students, in favour of making students demonstrate that they "know and are able to do" on completion of course or program. Consequently, this approach signifies a shift in the paradigm of the system of education from teaching to learning.

There is no single specified style of teaching or assessment in OBE. All educational activities carried out in OBE should help the student achieve the set goals. The faculty may adapt the role of instructor, trainer, facilitator, and/or mentor, based on the outcomes targeted.

The OBE approach is a continuous process of education wherein the curriculum, teaching and learning strategies, and assessment tools are improved continuously. The OBE learning process can be stated into four steps:

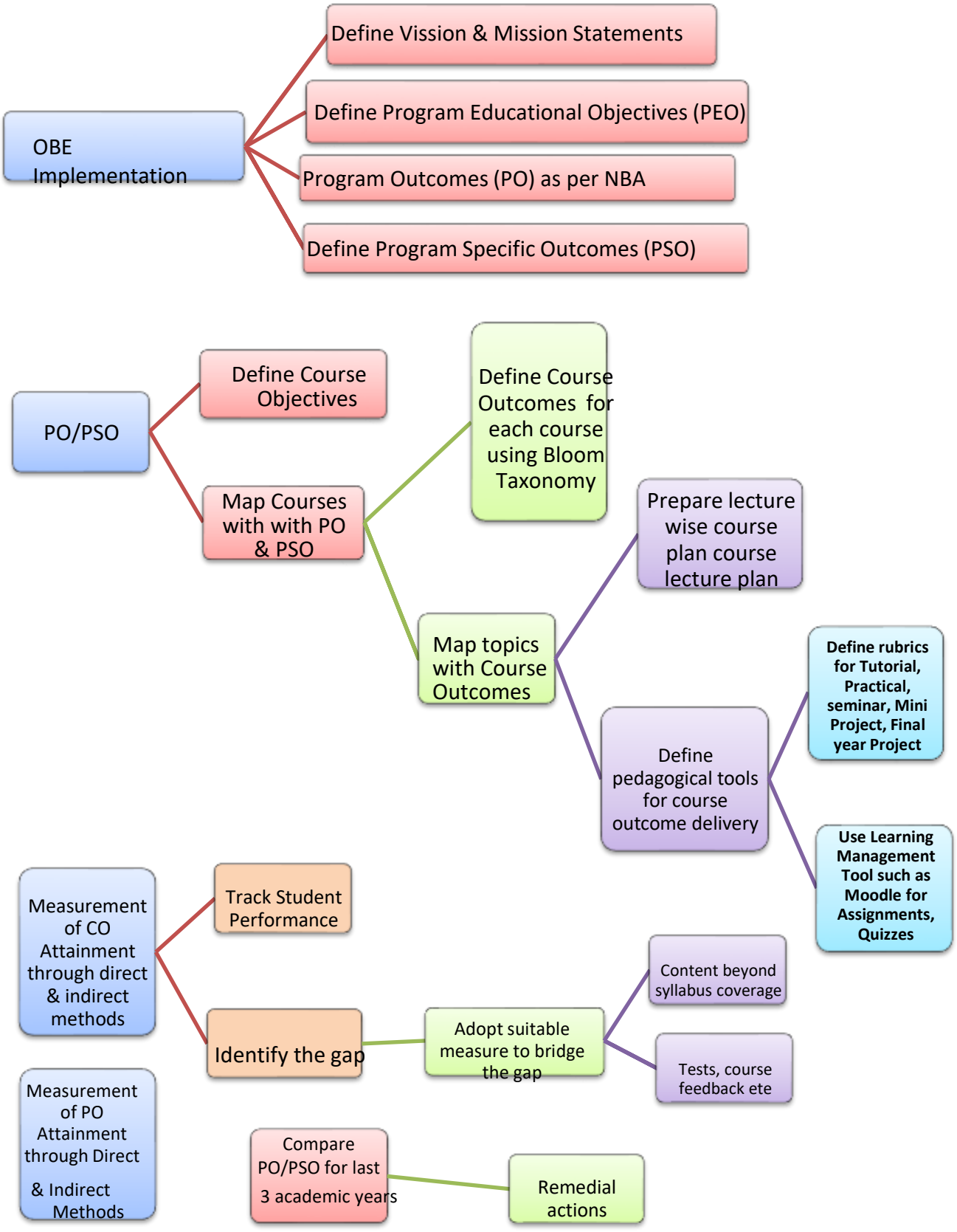
(a) Plan (Syllabus Writing/Review) — The Course Learning Outcomes are aligned with the ELGA, PEO and Student Outcomes. The syllabi reflect strategies (learning plan) for achieving the outcomes, as well as for measuring the outcomes (assessment).

(b) Implement (Course Delivery)- Carry out the learning plan and strategies planned for producing the outcomes.

(c) Measure / Assess (Assessment) – Carry out the strategies planned for measuring the learning outcomes and objectives. Collect this data and analyze it to determine the results. (Assessment Phase). This phase is where feedback is obtained.

(d) Respond / Improve (Continuous Quality Improvement) – Determine what needs to be changed to make improvements. These changes are the basis Of new or revised outcomes and objectives for the next cycle of the process. This process can be looked at on a program or course level.

The OBE Philosophy



OBE Implementation

Outcome-Based Education (OBE) is a student-centric learning model that helps teachers to plan the course delivery and assessment. It is implemented as per the following steps:

- Define Vision statements, Mission statements for the Institute and department
- Define Program Educational Objectives
- GA, PO & PSO Statements
- Define Course Objectives
- Map courses with Program outcomes at suitable levels of Bloom's Taxonomy
- Define Course Outcomes with Bloom's Taxonomy for each course
- Map topics with Course outcomes
- Prepare lecture-wise Course Lesson Plan
- Define pedagogical tools for course outcomes delivery
- Define rubrics for Tutorial, Practical, seminar, Mini Project, Final year Projec
- Use Learning Management Tool such as Moodle for Assignments, Quizzes, Content beyond syllabus coverage, Tests, course feedback etc.
- Measure the attainment of each CO through Direct/Indirect assessments
- Track students performance
- Identify Gaps in the Curriculum and adopt suitable measures to bridge the Gap
- Compare PO/PSO for last 3 academic years and propose remedial actions
- Assess the attainment of Program Educational Objectives

Vision and Mission statements

Establishing the vision and mission statement of any institute should be the first and foremost step when implementing OBE.

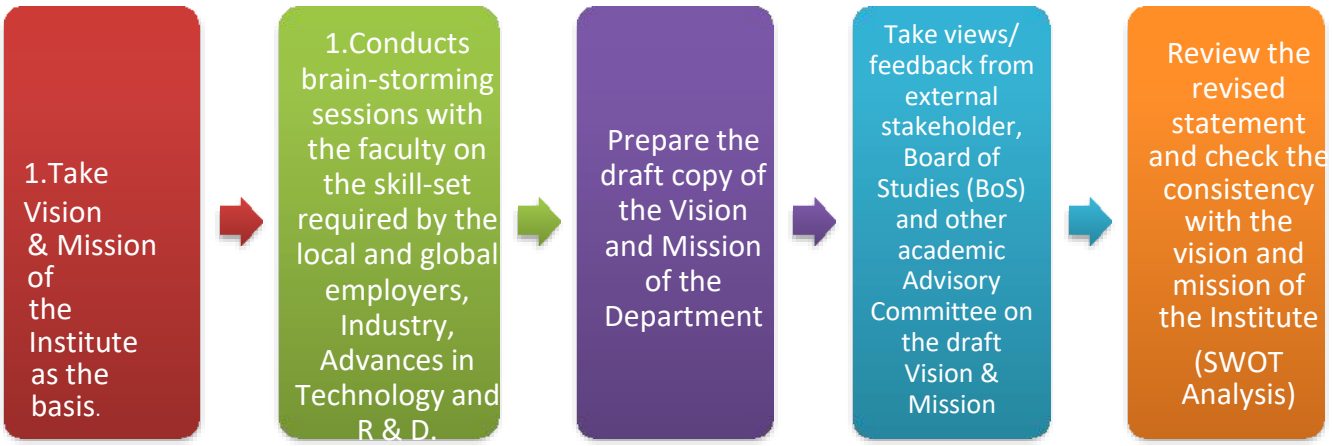
Vision:

- A vision statement states the current and future objectives of a Department.
- Vision statement is intended as a guide to help the department make decisions that align with its philosophy and declared set of goals.
- The statement gives a vivid picture of an ambitious desirable future state of an organization.
- Its purpose is to inspire to act as a guide for decision making & planning**.**

Characteristics of Vision statement

Mission

The mission statement should define the broad purposes the program /department is aiming to achieve, describe the community the program /department is designed to serve, and state the values and guiding principles which define its standards. Formation of the Vision, Mission and PEO is an iterative process which involves all the stakeholders of the Program. The following steps are followed to establish the Vision and Mission of the Department:



Institute Vision & Mission

Vision

- **To create world class quality Engineers and Technocrats capable of providing leadership in all spheres of life and society**

Mission

- **To provide quality education in technical and allied disciplines.**
- **To organize and arrange innovative courses in Engineering and Technology.**
- **To arrange vocational courses in the upcoming fields and innovative subjects to meet global advancement.**
- **To promote research in the fields of Technology and Science.**

Department Vision & Mission

Vision

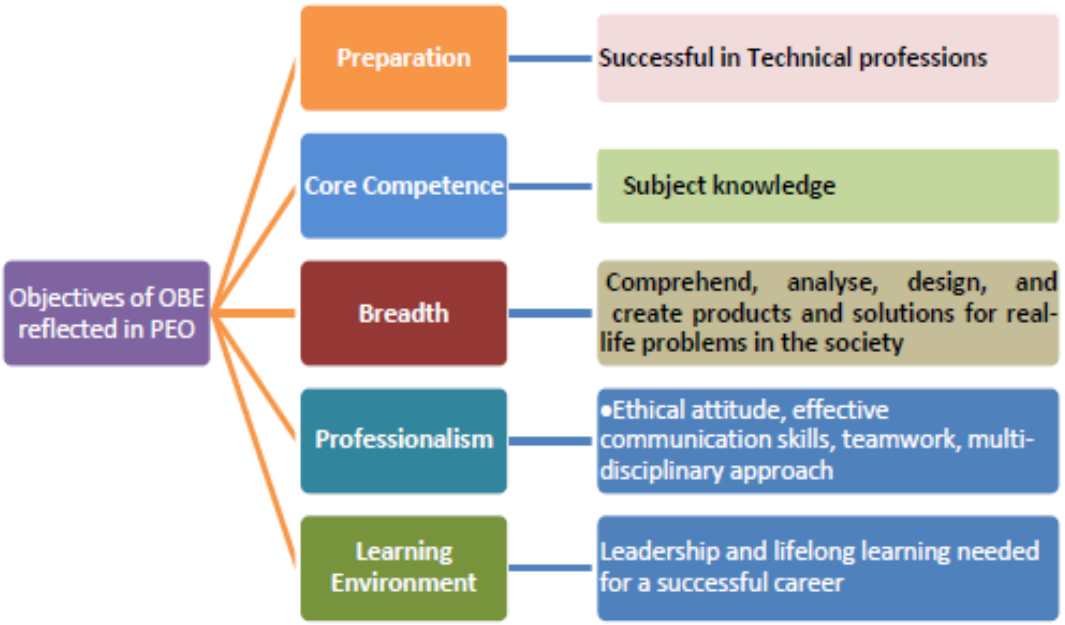
- **To Prepare Professionally Competent Electrical Engineers for Global Industrial requirements and Social needs**

Mission

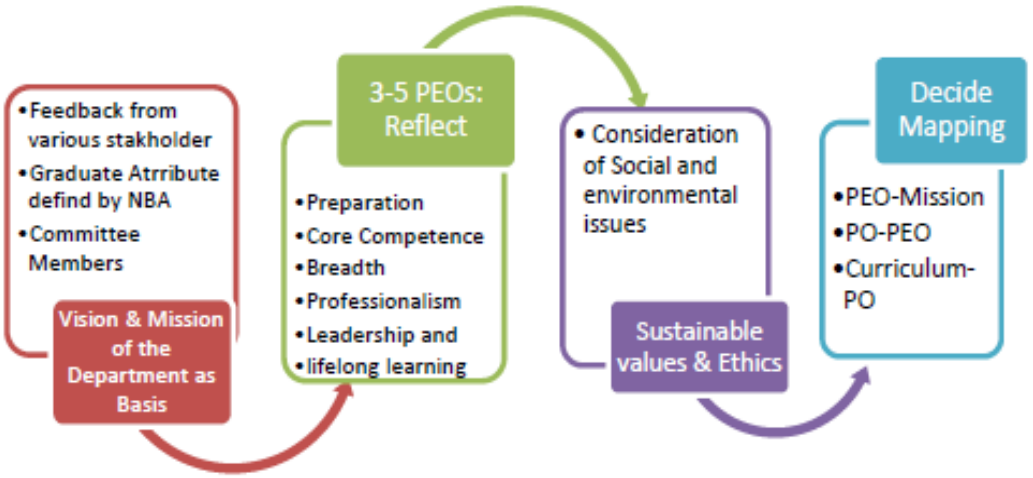
- M1. Impart state-of-the-art technical education at UG, PG and Ph.D. levels through good academic support & facilities. (Academic Development)
- M2. Keep pace with latest technological developments in the domain. (R&D Activities)
- M3. Effective interactions with industries, academia and other stakeholders. (Industrial & Societal needs)
- M4. Provide training on soft skills, managerial skills and professional ethics for overall development of students and society in an ethical manner. (Human Potential Development)

Program Educational Objectives (PEOs):

- PEOs are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.
- Knowledge, Skill and Attitude are the three behavioural elements based on which PEOs are constructed.
- PEOs are broad marketing statements.
- PEOs describe the career and professional accomplishments that the program is preparing graduates to accomplish after 3 to 5 years of graduation.
- PEOs are promises made by the institute to the stakeholder (Employers, students etc)
- PEOs should be measurable, appropriate, realistic, and achievable.



Process of defining PEOs of the Department



The draft copy of the PEOs of the Department is revised based on the inputs from stakeholders and consistency with the vision and mission of the Department is check each time.

Examples of PEOs:

- **PEO1:** Graduates will have successful careers in core and allied fields of Electrical Engineering
- **PEO2:** Graduates will have technical and analytical abilities and skills suitable to cater to industrial and societal needs
- **PEO3:** Graduates will follow professional ethics and display an attitude of continuous learning

Mapping Mission statements with Program Educational Objectives

- The program educational objectives (PEOs) should fall in line with the Mission statements. The BoS of the department is to establish consistency of the PEOs with the Mission of the department.
- There are distinct elements of the mission statements such as academic development, industrial & social needs, human potential development etc.
- These key elements capture some key aspects of the PEO statements. On the basis of this, the correlation is established between PEOs and such distinct elements of mission statements, the correlation is quantized the correlation levels need to be entered as 1 or 2 or 3.
- "1" means that the correlation is low or slight, "2" means that the correlation is moderate or medium and "3" means that the correlation is substantial or is very high.
- To ensure the proper mapping of Mission and PEO, the following Table is required to be prepared by taking inputs from the various stakeholders.

Mission Statements	**M1:** Impart state-of- the-art technical education at UG, PG and PhD levels through good academic support facilities **(Academic Development)**	**M2:** Keep pace with latest technological developments in the domain **(R&D Activities)**	**M3:** Effective interactions among industries, academia and other stake holders **(Industrial & Societal Needs)**	**M4:** Impart soft skills, managerial skills and professional ethics for overall development of students and society in an ethical manner **(Human Potential Development)**
PEO 1: Successful technical and professional careers **(Preparation)**	3	2	3	2
PEO 2: Continue to learn and adapt in a world of constantly evolving technology **(Life-long Learning)**	2	3	2	2
PEO 3 Able to apply, analyze, design and create products and solutions for real life Electrical Engineering problems **(Core competence)**	3	2	3	2
PEO 4 Manage projects catering to current societal and industrial needs in an ethical manner working as members/leaders of multidisciplinary teams **(Teamwork, Intrepreneurial skills)**	2	3	3	3

GA, PO & PSO Statements

Graduate Attributes (GAs):

- The GAs are exemplars of the qualities and attributes expected of a graduate from an accredited programme.
- Graduates Attributes (GAs) are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level

Program Outcomes (POs):

- Program outcomes are statements that describe what students are expected to know and be able to do upon graduating from the program.
- These relate to the skills, knowledge, analytical ability, attitude, and behavior that students acquire through the program at the end of 4 years.
- The POs essentially indicate what the students can do from the knowledge acquired by them during the program.
- As such, POs define the professional profile of an engineering graduate. NBA has defined the following 12 POs for an engineering graduate and are applicable to all engineering programs:

Program Outcomes (POs) defined by NBA

PO1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem Analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **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.

PO6. **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.

PO7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-Long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

- Program Specific Outcomes are statements that describe what the graduates of a specific engineering program should be able to do.
- PSOs characterize the specificity of the core courses of a program.
- The POs are important as a guideline when developing or revising the course outcomes.
- PSOs are defined based on the Centre of Excellence of the Department.
- Generally, 2 to 4 Program Specific Outcomes (PSOs) that the graduates of the program will attain should be defined for each department.

Course Outcomes (COs):

- It is a detailed description of what a student must be able to do at the end of a course.
- COs are the statements of Knowledge/ Skills/ Attitude that students are expected to know, understand and perform, as a result of learning experiences.
- Course Outcome remains the base of the hierarchy of outcomes and is the tools that can be used to measure student performance in each course.
- The course outcomes need to be concise descriptions of what learning is expected to take place by course completion.
- It should be narrower and measurable statements
- Well-written COs facilitate the faculty in measuring the achievement of the CO at the end of the semester. It also helps the faculty in designing suitable delivery and assessment methods to achieve the designed COs.
- New COs are developed when a new course is offered.

Writing/ Framing COs

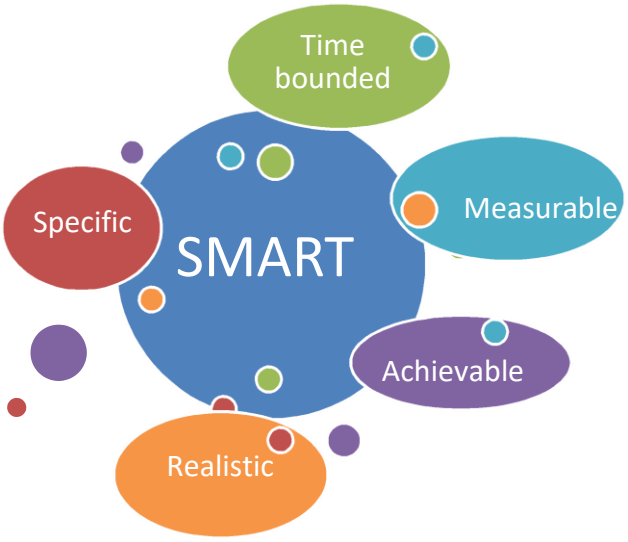
Well-written CO facilitates the faculty in measuring the achievement of the CO at the end of the semester.

- The CO statements are defined by considering the course content covered in each module of a course.
- Focus on the learning that results from the course rather than describing activities or lessons that are in the course.

- Create statements that have a student focus rather than an instructor centric approach.
- For every course there may be 5 or 6 Course Outcomes.
- The keywords used to define CO are based on Bloom's Taxonomy.
- It also helps the faculty in designing suitable delivery and assessment methods to achieve the designed Course Outcomes.

Rules to Develop COs

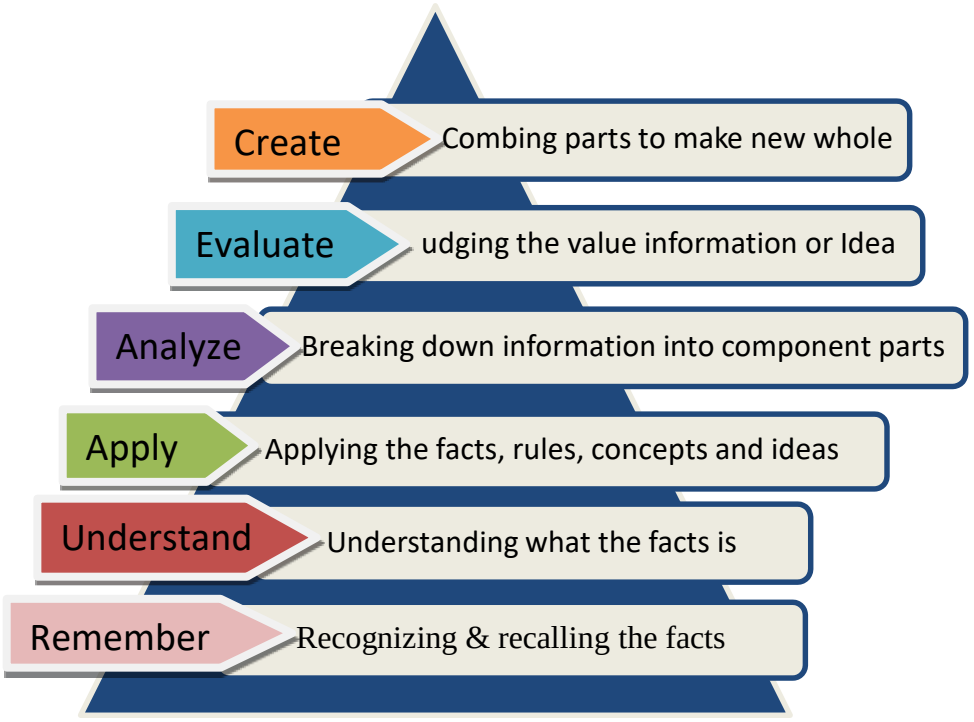
The rules to develop COs are **SMART**.

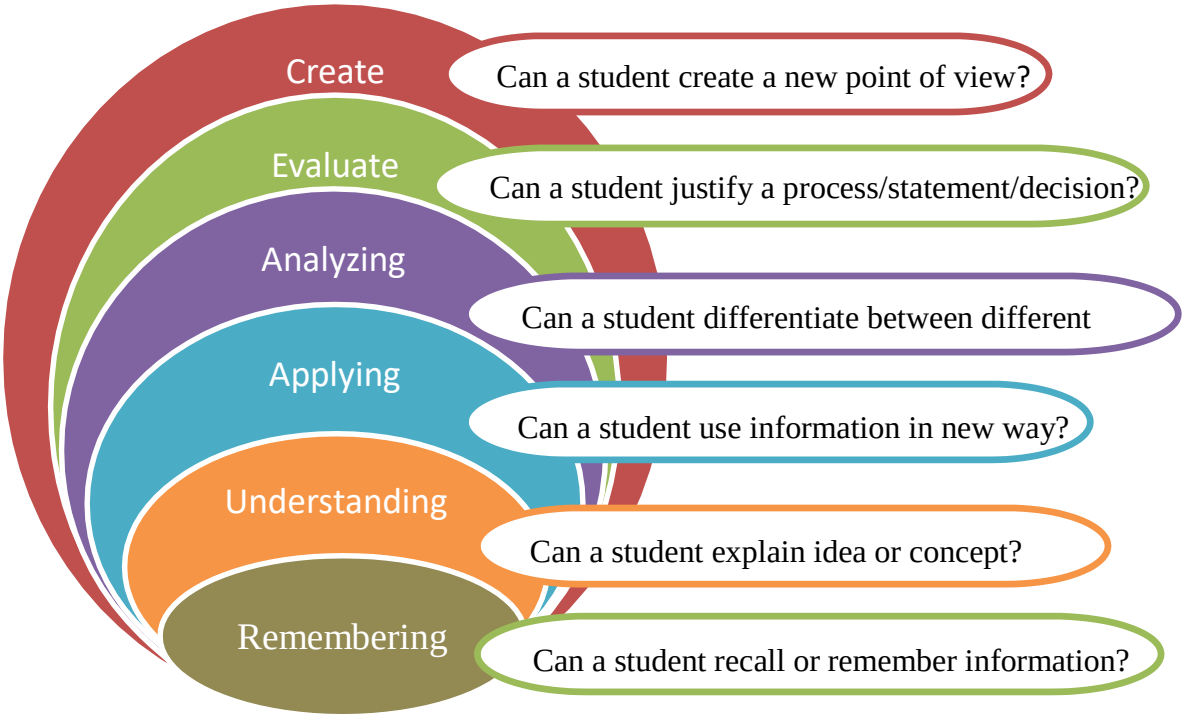


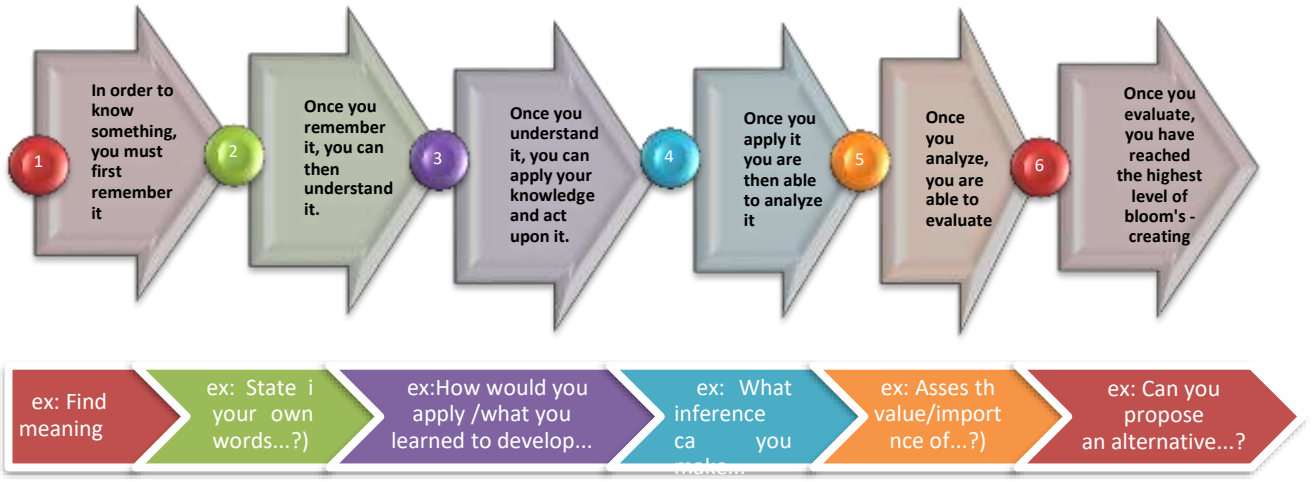
- **Specific**: Students can state what they should be able to achieve from reading the outcomes.
- **Measurable**: Students can be able to recognize when they have achieved the outcomes.
- **Achievable**: It is genuinely possible to complete the outcomes in the time and with the resources available.
- **Realistic**: Outcomes are appropriate for the student.
- **Time bounded**: Outcomes have a time limit for completion

Action Verbs for Course Outcomes: Blooms Revised Taxonomy

There are six levels of cognitive learning according to the revised version of Bloom's Taxonomy. Each level is conceptually different. The six levels are remembering, understanding, applying, analyzing, evaluating, and creating. Bloom's Taxonomy is frequently used in writing the course outcomes as it provides a readymade structure and list of action verbs. All levels of Bloom's taxonomy of thinking skills can be incorporated into expected learning outcome statements. Recently, Anderson and Krathwohl (2001) adapted Bloom's model to include language that is oriented towards the language used in expected learning outcome statements. A summary of Anderson and Krathwohl's revised version of Bloom's taxonomy of critical thinking is provided in Figure below:


Create
Combing parts to make new whole
Evaluate
udging the value information or Idea
Analyze
Breaking down information into component parts
Apply
Applying the facts, rules, concepts and ideas
Understand
Understanding what the facts is
Remember
Recognizing & recalling the facts


Create
Can a student create a new point of view?
Evaluate
Can a student justify a process/statement/decision?
Analyzing
Can a student differentiate between different
Applying
Can a student use information in new way?
Understanding
Can a student explain idea or concept?
Remembering
Can a student recall or remember information?

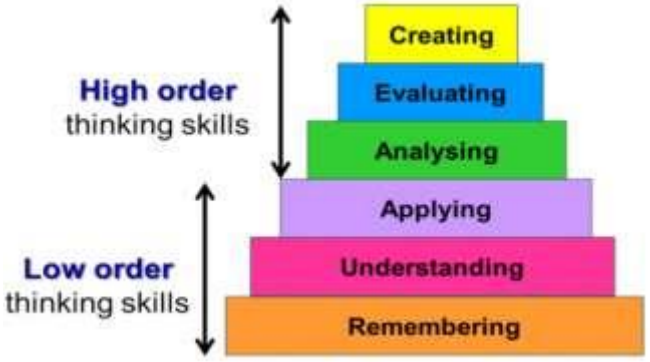


Lower Order Thinking Skills

Based on Bloom's taxonomy of critical thinking, Lower Order Thinking Skills have three levels. They are Remembering, Understanding and Applying.

Higher-order thinking skills

The higher-order thinking skills include Analyzing, Evaluating, and Creating. It consist of complex thinking that achieves more than the basic recall of facts. Higher-order thinking skills enable students to retain information learned, and apply problem-solving solutions to real world problems**.**



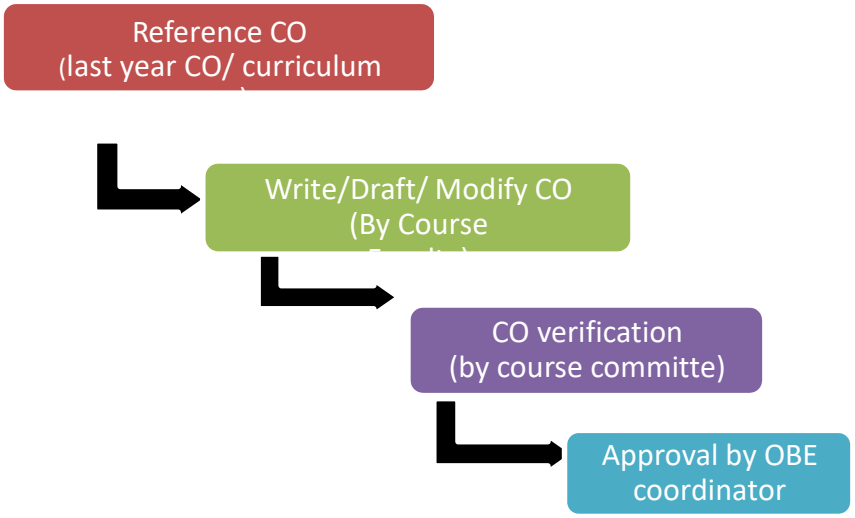
The sample list of action words that can be used when creating the expected student learning outcomes related to critical thinking skills in a course

Lower Order of Thinking (LOT)			Higher Order of Thinking (HOT)		
Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Define	Explain	Solve	Analyse	Reframe	Design
Describe	Describe	Apply	Compare	Criticize	Create
List	Interpret	Illustrate	Classify	Judge	Plan
State	Summarise	Calculate	Distinguish	Recommend	Formulate
Match	Compare	Sketch	Explain	Grade	Invent
Tabulate	Discuss	Prepare	Differentiate	Measure	Develop

Record	Estimate	Chart	Appraise	Test	Organize
Label	Express	Choose	Conclude	Evaluate	Produce
Choose	Illustrate	Make use of	Discover	Choose	Compile

Process to maintain Quality of the Course Outcomes

- After the course (subject) allotment from the department, identify the expected learning outcomes from the course i.e. what knowledge or skills from this course will students will acquire to perform well in the future. Make a list of learning outcomes first.
- Look over the list and check the most important learning outcomes.
- Identify 4 to 6 most important learning outcomes from the course using the action verbs of learning levels.
- It should be related to the skills, knowledge, and behaviour that students will acquire through the course.
- Check how clear and how important are the statements of outcomes for the students?
- Check each of the most important outcomes identified against the list of program outcomes stated the by NBA.
- How many are on the list of key competencies of program outcomes?
- Existing COs are revised upon feedback from stakeholders or during the cycle of Curriculum Review.



Observations:

- For the theory courses, while writing the COs, restrict between Blooms Level 1 to Level 4.
- For the laboratory courses, while composing COs, restrict between Blooms Level 1 to Level 5.
- For mini-project and major projects, extend up to Blooms Level 6 while composing COs

Example of Course Outcomes:

Relation between POs and COs: CO-PO Mapping

Before developing the relationship between the CO and PO, it is necessary to understand the action verbs used in the PO statements. The table shows the PO with action verbs and corresponding Bloom levels.

PO	Action verbs (keyword) in PO	Blooms Level for PO
PO1	Apply	L3
PO2	Identify	L2
	Formulate	L6
	Review	L2
PO3	Design	L6
	Develop	L3, L6
PO4	Analyze	L4
	Interpret	L2, L3
	Design	L6
PO5	Create	L6
	Select	L1, L2, L6
	Apply	L3
PO6-PO12	-	-

- The Course Outcomes should be mapped with at least one of the PO i.e. all POs can be adequately addressed through the selection of core courses and their COs
- When designing the COs, faculty handling the course should map their COs to the appropriate PO in order to ensure that all POs are delivered throughout the period of study.
- Write the COs for a course and see to what extent each of those CO's correlate with the POs.

Process of CO-PO mapping

CO-PO Mapping Guidelines

Most of the time, the appropriate keyword of PO and CO is sufficient for mapping. The various mapping levels for the COs and POs mapping is assigned on a four-point scale: '-' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level). In order to complete the CO-PO articulation matrix, the first step is to identify the keywords of POs/PSOs to each CO and then make a corresponding mapping table assigning correlation levels at the corresponding cell. These correlation level to CO-PO matrix can be assigned as given in Table below:

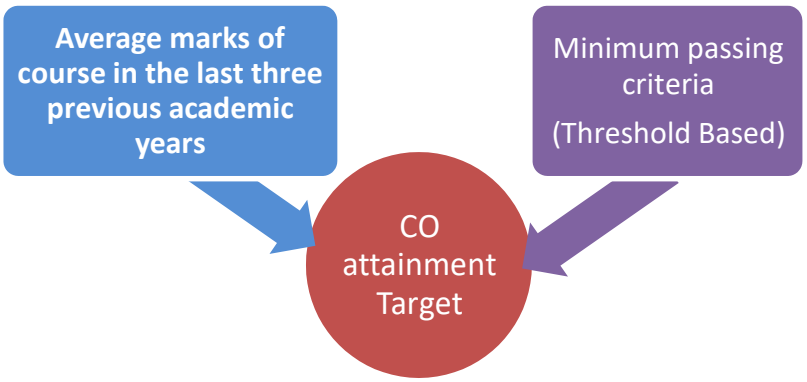
Action verb/ Keywords Used in Writing COs	Mapping Level
Keywords/action verb of the Course Outcome is not related to the action verb of Program Outcomes	'-'
Part of PO is reflected through keywords/action verbs of CO	'1' (Low)
Major part of PO is reflected through keywords/action verbs and moderate level performance is expected from student to achieve CO	'2' (Medium)
Exact action verb of PO and critical performance expected from student to achieve CO	'3' (High)

Sample of CO-PO Mapping

CO	Statement	PO1. Engineering Knowledge	PO2. Problem Analysis	PO3. Design / development of solutions	PO4. Conduct Investigations of Complex Problems	PO5. Modern Tool Usage	PO6. The Engineer and Society	PO7. Environment and Sustainability	PO8. Ethics	PO9. Individual and Team Work	PO10. Communication	PO11. Project Management and Finance	PO12. Life-long learning	PSO1	PSO2
CO1	**Explain** the construction and working principle of electrical and electronic measurement and measuring instruments.	3	2	2	2	-	-	-	1	1	1	2	-	2	-
CO2	**Estimate** errors in a measurement system	3	3	2	2	-	2	-	2	1	1	2	1	-	-
CO3	**Describe** the construction and working of AC and DC bridges and their applications	3	3	-	-	-	-	-	1	1	1	-	-	-	-
CO4	**Select** a suitable measuring instrument, signal Generator, frequency counter, CRO and digital IC tester for appropriate measurement	3	-	3	3	2	-	-	1	1	1	-	-	-	-
CO5	**Select** appropriate passive, active transducers and A/D & D/A converters for measurement of a physical quantity	3	3	-	3	2	-	-	1	1	1	1	1	-	2
CO6	**Apply** CT & PT for instrument range extension	3	2	3	3	2	-	-	1	2	1	1	-	-	-

Setting Target for CO Attainment

- Target level for attainment of COs can be set initially based on average marks of that course in the last three previous academic years.
- However, it can also be based on some threshold (minimum passing criteria or some other threshold level) i.e. 60 % or maximum marks allocated to CO etc.



Guideline for setting Threshold/Benchmark

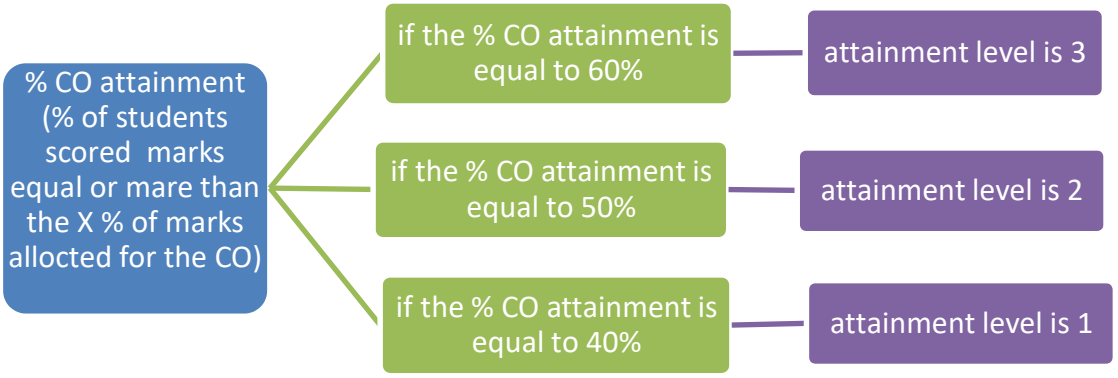
S.No.	Average % result in last three	Target
1	< 40%	40%
2	Above 40% but less than 50%	50%
3	Above 50 %	60%
4	Above 70 %	70%

» **Same target for all the COs of a course**

» For example, the target for all the course outcomes can be >= 60% of the maximum marks allocated to CO.

Level of attainment

Here 3 levels of attainment are taken as 1-Low; 2-medium; 3- High. These 3 levels of attainment can be defined as:



» **Targets can be set for each CO of a course separately.**

	CO1	CO2	CO3	CO4	CO5
Threshold Target	60%	75%	65%	80%	70%

Procedure for computation of CO attainment

Course outcomes will be attained through direct and indirect methods.

- **Direct Attainment:**

The following criteria are considered in the direct attainment

- **Conduction of Two Mid Semester Examination based on COs**
- **Class performance activities**
  - » Assignments
  - » Tutorials
  - » Skill based Mini Projects
  - » Quizzes
  - » Case studies related to COs
- **End Term Examinations**

The proportional weightages of the above criteria are as per the institute academic regulations.

- **Indirect Attainment:**
  - » Feedback from student on the framed questionnaires

- Course End Seminar
- One-minute paper writing

Direct Assessment tools

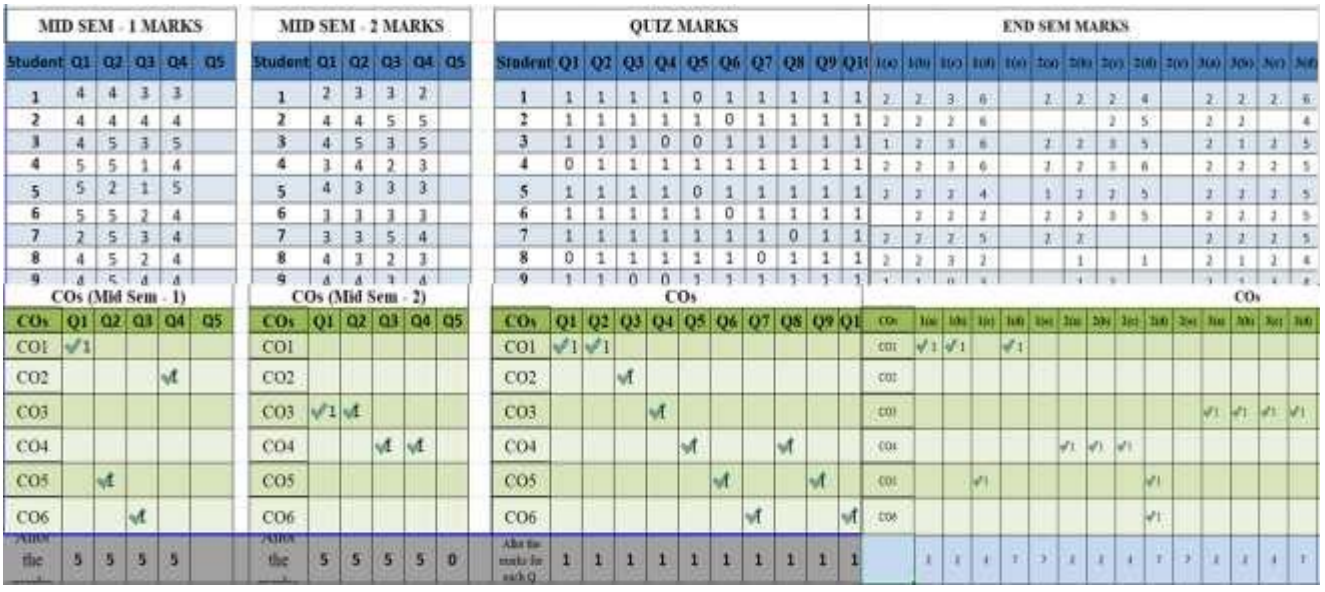
- The various internal assessment tools should be in alignment with the COs for different subjects. All the assessment are mapped to action verbs so that they help to measure the performance of students.
- Question paper should be so set to assess all CO. The marks obtained in assessments against items for each CO will indicate the CO attainment.
- Faculty can set targets for each CO of his/her course Attainment gaps can therefore be identified
- Faculty can plan to reduce the attainment gaps or enhance attainment targets.

A common format of programmed excel sheet, prepared in the Institute, is initially being used for finding the attainment of COs. Each course faculty computes the attainment as per the appropriate assessment tools considered. Once the marks of each student in internal assessment tests and assignments and other internal evaluation metrics are entered, the CO attainment can be measured for each class.

Measurement CO attainment

The Course Outcome (CO) is measured through the performance of students in the various assessment tools for the particular course. The first step is to collect the marks obtained by the students in each assessment tool. Also mapping of CO to the question ask is done shown in the sample sheet given below.

Step-I: Data Collection

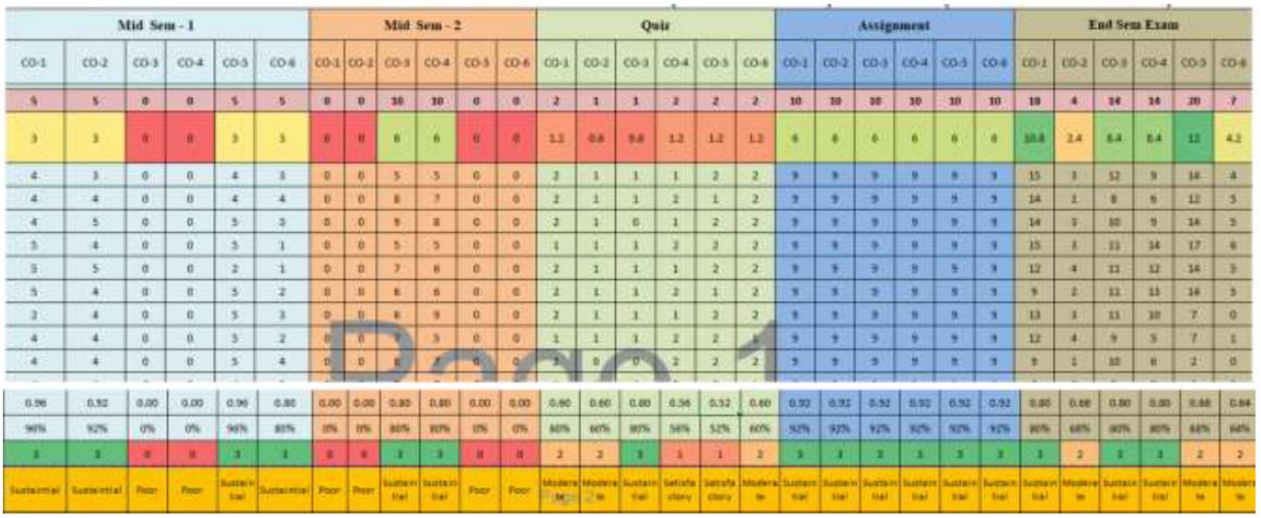


Step-II: Computation of % CO attainment

After mapping the questions to the course outcomes, it is required to set the reference or the bench mark for each CO. for example, if it is set to 60%, then all those students will be considered for computation of %CO attainment who has scored greater than or equal to the 60% of maximum marks allocated to that CO.

Once the benchmark/threshold is set, then % attainment is computed by counting the number of students who have reached the benchmark. The formula used for computation of CO attainment by any assessment tool used is:

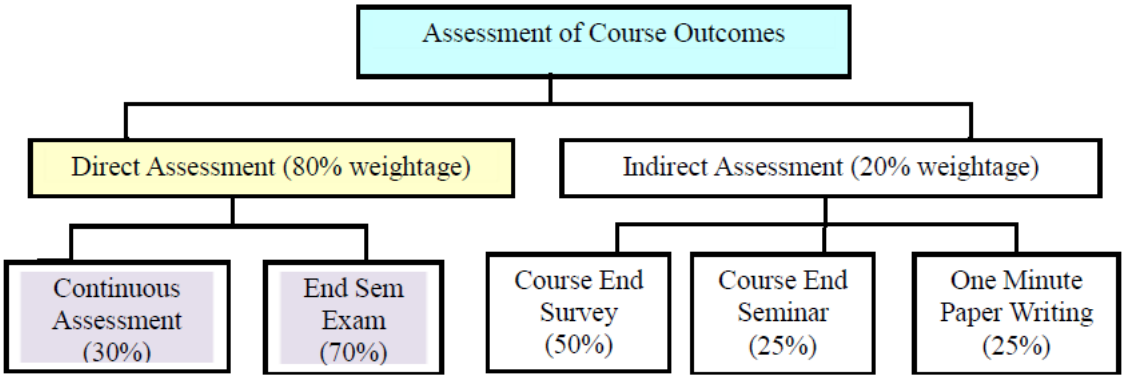
$$\%\,\text{CO Attainment} = \frac{\text{Number of students scored marks eqal \& above threshold}}{\text{Total number of students appeared in the assessment}} \times 100$$



Procedure for attainment of COs:

Course outcomes will be attained through direct and indirect methods.

- Direct Attainment: We will consider the following criteria in the direct attainment
  - Two Internal tests will be conducted based on COs
  - Class performance activities consisting of assignments /tutorials/experiments/quiz/ any other activity related to COs will be conducted
  - External exam marks will be considered.
- Indirect Attainment: In this method, we consider the feedbacks of students, parents, alumni and parents on the framed questionnaires.



Mapping Questions with Course Outcomes at appropriate levels of Bloom's Taxonomy and maps it with assessments

Questions are framed using Bloom's Taxonomy verbs (both during the class test and written assignments) from the remember, understand, apply, analyze, evaluate, and create levels of the taxonomy pyramid**.** The questions are framed in such a way that it should satisfy Bloom's Taxonomy, wherein each question is mapped to the appropriate course outcome of the respective course, which is evaluated based on the set attainment levels by the department.

Rubrics for activities such as Seminars, projects, internships, Lab assignments etc.

Although it is appropriate enough to measure the learning of the students based on the level of Bloom's Taxonomy, Rubrics are used to cater to the different levels of learners, should measure their capabilities, and should be mapped with the course outcomes.

Rubrics for Project

Scale Criteria of Assessment	**Fair 1 pts**	**Good 2 pts**	**Excellent 3 pts**	**Outstanding 4 pts**	**Weight**	**PO**	**CO**
Problem Statement	• Unable to find specific details.	• Objective and motivation of the project are not clear or described.	• Some lack of clarity in objectives/purpose. • The motivation for pursuing the project are somewhat clear, but no support provided.	• The project's objectives are clearly stated. • The motivation for pursuing the project and its relevance are clearly stated.	10 %	1, 2, 6, 7	1,2 ,3
Related work/ Literature Review	• Little attempt is made to acknowledge the work of others. Most references that are included are inaccurate or unclear • Insincerely following professional ethics like anti-plagiarism, citing references, negative response to suggestions	• Some related work described, but unclear as to how they relate to the project or the link to the project is questionable • Follow professional ethics like anti-plagiarism, not citing references, careless response to suggestions	• With some minor exceptions, references are exact with author, journal, volume number, page number, and year. • Follow professional ethics like anti-plagiarism, citing references, partial response to suggestions.	• Prior work is acknowledged by referring to sources for theories, assumptions, quotations, and findings. • References are exact with author, journal, volume number, page number, and year. • Follow professional ethics like anti-plagiarism, citing references, positive response to suggestions.	10 %	1, 2, 8	2
Type and Relevance of Project	• Unable to identify the skills relevant to the objective of project.	• Able to identify the skills relevant to the objectives of project but not able to apply properly.	• Able to apply the skills relevant to the objectives of project but needs improvement in application.	• Able to apply skills in such a manner that it fulfills the objectives of project.	20 %	3, 4, 5	2,3
Project Management	• Time frame not properly specified. • In-appropriate distribution of project work.	• Time frame properly specified, but not being followed. • Un-even distribution of	• Time frame properly specified, but not being followed.	• Time frame properly specified and being followed.	10 %	9, 11	4

		project work and no synchronization.	• Distribution of project work un-even.	• Appropriate distribution of project work.			
Report	• Submission of report within a week. • Poorly organized; No logical progression; Beginning and ending are vague.	• Submitted report with few major errors on the day of presentation. • Some organization; Points jump around; Beginning and ending are unclear.	• Submitted report with minor errors on the day of presentation. • Organized; Points are somewhat jumpy; Sense of beginning and ending.	• Submitted report in required format on the day of presentation. • Good organization; Points are logically ordered; Sharp sense of beginning and end.	30 %	10, 8	5
Presentation	• Contents of presentations are not appropriate and not well delivered	• Contents of presentations are not appropriate but well presented	• Contents of presentations are appropriate but not well arranged	• Contents of presentations are appropriate and well arranged	20 %	10	6
Overall Rating/ Comments							

Rubrics for Industrial Visit

Scale ***Criteria of Assessment***	**1pts: Slight (Low)**	**2pts: Moderate (Medium)**	**3pts: Substantial (High)**	**Weight**	**PO**
Purpose of the Training	Does not clearly explain the intended outcome of the training or provides little information about the departments, processes, products of the industry that was being visited.	Provides a description of the intended outcome of the training but not clear about the departments, processes, products of the industry that was being visited.	Provides a detailed intended outcome of the training which includes information about the departments, processes, products of the industry that was being visited.	30 %	2
Recognize a variety of working and learning preferences; appreciate the value of diversity on a team	Minimal knowledge of work culture of Industry. Not able to identify technical and non-technical information.	Moderate knowledge of work culture of Industry. Able to read technical and non-technical information, but could not understand and interpret.	Extensive knowledge of work culture of Industry. Able to provide detailed and extensive explanation of the specifications and the limitations of the existing systems.	40 %	6, 7, 8, 9, 10, 11, 12
Report Writing	Produces a report but the report is not clear and not well-constructed.	Produces a report but needs some modification.	Produce clear, well-constructed, and well-supported written engineering documents.	30 %	10

Attainment of Program Outcomes and Program Specific Outcomes

Attainment of POs and PSOs is computed by using direct and indirect assessment methods. The direct PO and PSO assessment is through course outcomes attainment, whereas indirect assessment is based on the survey/ feedback obtained from stake holders.

Direct Assessment

Process for Direct Assessment:

1. CO-PO matrix is developed for each course.
2. The PO attainment for given CO attainment in a course is computed as follows:
    a. The CO attainment data is multiplied by the mapping strength (1, 2 or 3).
    b. Above step is repeated for all COs of the course for given PO.
    c. The weighted COs attainment so obtained are added.
    d. d. Weighted sum is then divided by the total mapping strength of that PO with all COs of the course.
3. Step a-d are repeated for each PO mapping with the course.
4. Step i-iii is repeated for all courses.
5. The average of PO attainment in individual Courses is the final direct PO/PSO attainment in the level of 1,2 &3.

Indirect Assessment Tools:

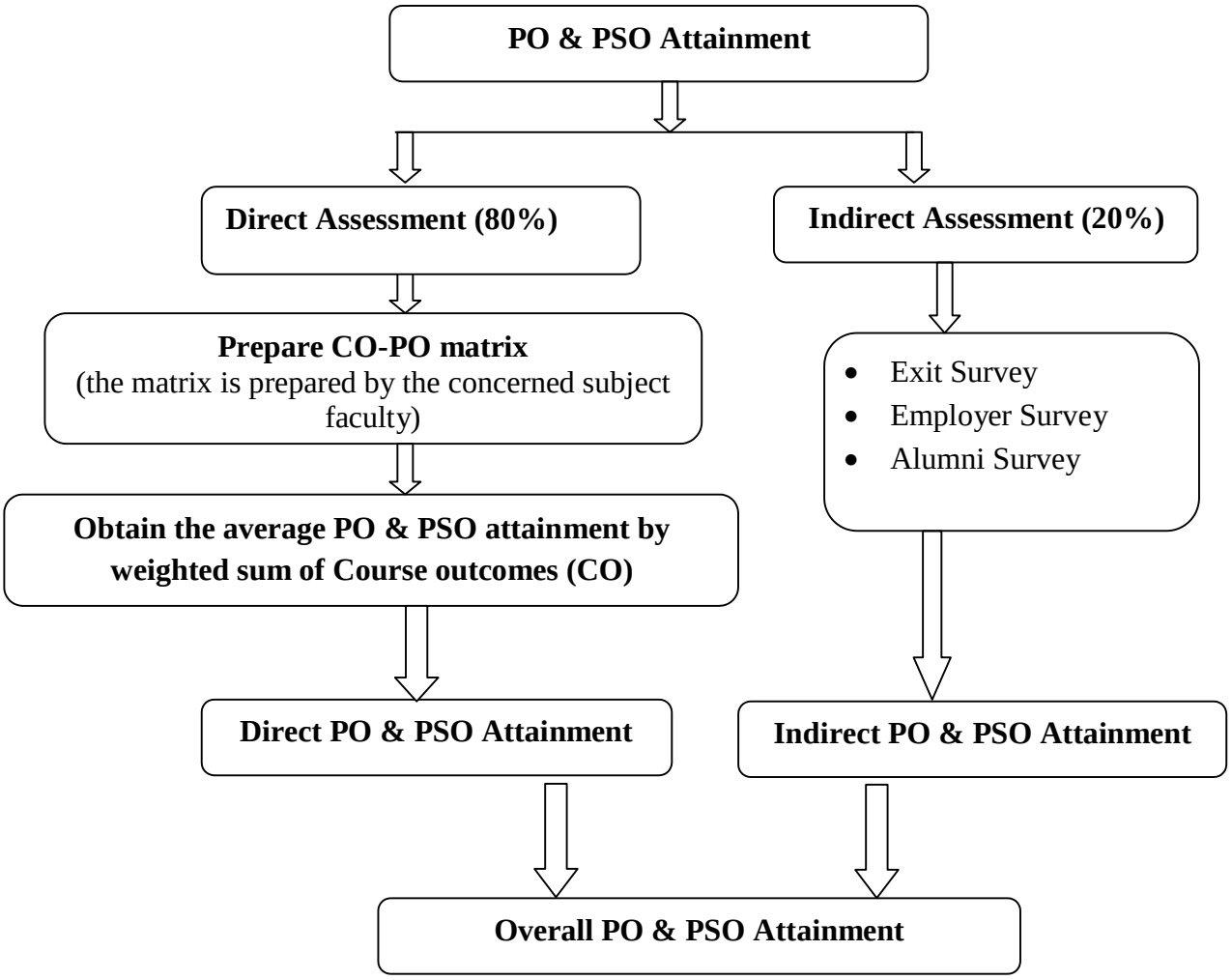
1. Feedback and survey questionnaire with score/level for each question is prepared for all the stake holders.
2. Graduate Exit Feedback is taken by the students.
3. Alumni, particularly who has graduated within the 3-4 years of current academic year, feedback is taken on POs & PSOs.
4. Industrial Feedback is taken from industry persons

Overall PO/PSO attainment:

Data thus obtained is consolidated and average value is computed. The average value obtained is the final indirect PO attainment. The Overall PO/PSO attainment is calculated using the rubric:

PO/PSO Attainment (Overall) = 0.8xDirect Attainment + 0.2x Indirect Attainment

The process adopted for PO & PSO attainment:



Sample PO Attainment Computation

Course outcome

CO1	2.76
CO2	2.2
CO3	2.8
CO4	2.72
CO5	2.16
CO6	2.2

CO-PO Mapping

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
3	3	3	-	-	-	-	1	1	1	2	-	2	-
3	3	-	2	-	2	2	2	1	1	2	1	-	-
3	3	-	-	-	-	-	1	1	1	-	-	-	-
3	-	3	3	2	-	-	1	1	1	-	-	-	-
3	3	-	3	2	-	-	1	1	1	1	1	-	2
3	-	3	3	2	-	-	1	2	1	1	-	-	-

Sample Calculation:

Attainment of PO1

$=(3\times2.76+ 3\times2.2+ 3\times2.8+ 3\times2.72+3\times2.16+3\times2.2)/(3+3+3+3+3+3)$

$=2.47$

Attainment of PO5

$=(2\times2.72+2\times2.16+2\times2.2)/(2+2+2)$

$=2.36$

PO Attainment :Direct

S. No.	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	BEEL301: Electrical Engineering Materials	2.17	2.17	2.19	2.20	2.17		2.13					2.25	2.17	
2	BEEL302: Measurement & Instrumentation	2.47	2.61	2.31	2.42	2.39	2.56		2.48	2.37	2.47	2.48	2.68	2.57	2.80
3	BEEL302: Measurement & Instrumentation (LAB)	2.79	2.79	2.79	2.79		2.79	2.79	2.79	2.79	2.79				2.79
4	BEEL303: Network Analysis	2.83	2.83	2.83	2.83	2.83	2.77	2.87	2.83	2.83	2.83		2.83	2.81	2.81
5	BEEL303: Network Analysis (LAB)	2.84	2.82	2.82	2.80		2.80	2.80	2.80	2.80	2.80				2.80
6	BEEL304: Analog Electronics	2.17	2.17	2.17	2.17		2.17			2.18				2.17	
7	BEEL304: Analog Electronics (LAB)							2.81	2.81	2.81	2.81	2.81	2.81		2.81
8	BEEL305: Electro Magnetic Field Theory	2.53	2.53	2.53						2.50				2.53	
9	BEEP306: Simulation Lab-I	2.86	2.79		2.86	2.86				2.86	2.86	2.86		2.86	2.86
10	BEEL307 : Idea Generation	2.82	2.82	2.82						2.82	2.82	2.82	2.82	2.82	2.82
11	BEEL308 : Communication Skills	2.79	2.79	2.79						2.79	2.79	2.79		2.79	
12	BEEL401: Mathematics-III	2.19	2.19	2.22	2.22	2.19		2.16					2.34	2.19	2.19
13	BEEL402: Electrical Machines-I	2.71	2.71	2.72	2.71	2.64	2.75	2.66	2.73	2.75	2.73	2.75	2.64	2.66	2.73
14	BEEL402: Electrical Machines-I (LAB)							2.81	2.61	2.61	2.61	2.65		2.60	
15	BEEL403: Digital Electronics & Microprocessor	2.34	2.40	2.40										2.30	
16	BEEL403: Digital Electronics & Microprocessor (LAB)						2.82	2.82	2.82					2.82	
17	BEEL404 : Linear Control Systems	2.45	2.45	2.45	2.44	2.46	2.78	2.45	2.45	2.45	2.65		2.68	2.68	2.75
18	BEEL404 : Linear Control Systems (Lab)					2.79	2.79	2.79		2.79	2.79	2.79	2.79	2.76	2.79
19	BEEL405: Signals & Systems	1.89	1.89	1.89	1.90	1.89	1.71	1.68	1.90	1.74	1.89	1.45	1.85	1.89	1.71
21	BEEP406: Simulation Lab-II	2.83			2.83	2.83								2.83	
20	BEES407 GD/Seminar	1.54	1.65	1.61	1.61	1.55	1.50	1.13	1.13	1.13	1.12		1.55	1.42	1.71
22	BEES408:Integrated Ethics & Apititude					2.53	2.59	2.66	2.66	2.63	2.53	2.59	2.66	2.66	2.63
32	BEEL-501:PMME						2.43		2.26	2.28	1.36	2.06		1.77	1.91
23	BEEL503: Non-conventional Energy Resources	1.84	1.83	1.72	1.85	1.62	1.91	2.00	2.20		1.82		1.82	1.62	1.63
24	BEEL504: Control System Design	2.46	2.46	2.46	2.46	2.46								2.46	2.46
25	BEEL504: Control System Design Lab														
26	BEEL505: Transmission and Distribution	1.98	1.98	1.98	1.98	1.98	1.96	1.98		1.98	1.98	1.98	1.98	1.98	1.98
27	BEEL505: Transmission and Distribution (LAB)	2.71	2.74	2.71	2.73	2.71	2.71	2.71		2.66	2.67	2.79	2.72		2.71
28	BEEL506: Electrical Machines-II	2.69	2.67	2.66	2.64	2.69	2.65	2.49	2.68	2.67	2.71	2.63	2.60	2.67	2.71
29	BEEL506: Electrical Machines-I(Lab)	2.69	2.66	2.69	2.69	2.69	2.66	2.76	2.76	2.75	2.75	2.79	2.69	2.77	2.69
31	BEEP507: Simulation Lab-III	2.78			2.78	2.78				2.78	2.78	2.78		2.78	2.78
30	BEES508/9 Self Study,Seminar & Group Discussion	2.82	2.82	2.82						2.82	2.82	2.82	2.82	2.82	2.82
33	BEEL602: Electric Machine -II	2.69	2.04	2.38	2.53	2.35	1.23						2.37	1.69	2.42
34	BEEL603: Power Electronics	2.54	2.54	2.54	2.54	2.54	2.44	2.24	2.54	2.61	2.51	2.45	2.57	2.49	2.49
35	BEEL603: Power Electronics (Lab)	2.44	2.45	2.46		2.46	2.46				2.46				
36	BEEL604: Advanced Microprocessor and Interfacing	2.18	2.11	2.16								2.18		2.18	

37	**BEEL605: Applied Instrumentation**	2.26	2.02	2.19		2.26	2.27							1.70	
38	**BEEL605 (LAB): Applied Instrumentation**								2.82	2.82	2.82	2.82	2.81		
39	**BEEL606: Power System Analysis and Control**	2.27	2.27	2.27	2.27	2.27	2.27	2.27		2.27	2.27	2.27	2.27	2.84	2.
40	**BEEL606 (LAB): Power System Analysis and Control**					2.79	2.80	2.79		2.79	2.79	2.79	2.79	2.76	2.
41	**BEEL 607: Minor Project**	2.83	2.83	2.83					2.82	2.82	2.82	2.82		2.82	2.
42	**BEES608/9 Self Study,Seminar & Group Discussion**									2.82	2.82			2.82	2.
43	**BEEL-701: Electric Drives**	2.15	2.35	2.32	1.22	2.09	2.36	2.32		2.44	2.27	2.32	2.09		
50	**BEEL 701: Electrical Drives Lab**	2.82	2.82	2.82		2.82			2.81	2.81					2.
44	**BEEL-702: Switchgear & protection**	2.27	2.21	2.14	2.25	1.78	2.25		2.25	2.22	2.22		2.19	2.22	2.
51	**BEEL 702: Switchgear & Protection Lab**	2.78	2.78	2.78		2.78									2.
45	**BEEL703: Computer Aided Power System**	2.65	2.72	2.68	2.67	2.73	2.62						2.55	2.69	2.
46	**BEEL704: Power System Economics**	1.95	2.18	1.71	2.20	2.03	1.51						1.49	2.18	2.
47	**BEEL 705: Energy Audit & Management**	2.03	1.93	2.04	2.17	2.06								1.96	1.
48	**BEEL706: Industrial Trainning & Internship**	2.85	2.71	2.91	2.82	2.80								2.75	2.
49	**BEED707: Major Project I**	2.85	2.85	2.85					2.86	2.86	2.86	2.86		2.86	2.
52	**BEES708 : Self Seminar & Group Discussion**									2.82	2.82			2.82	2.
53	**BEEL 801: Soft Computing Techniues**	1.97			2.01	2.67	2.67			2.01		2.01	2.01		2
54	**BEEL 801: Soft Computing Techniues (Lab)**	1.97			2.01	2.67	2.67			2.01		2.01	2.01		2.
55	**BEEL 802: Utilization of Electrical Energy**	2.25	2.24	2.16	2.24	1.55	2.21	2.21	2.24	2.21	2.21	2.21	2.13	2.18	2
56	**EEL803A: Process Instrumentation**	2.55	2.55	2.68	2.68									2.68	2
57	**BEEL804A: High Voltage Engineering**	2.20	2.20	2.07	2.07									2.07	2
58	**BEEL 805: Major Project**	2.85	2.85	2.85					2.86	2.86	2.86	2.86		2.86	2
59	**BEEL 806: Electrical Industrial Safety & Maintenance**	2.78	2.78	2.78					2.78	2.78	2.78	2.78		2.78	2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
PO Attainment Direct	2.47	2.47	2.45	2.38	2.42	2.39	2.44	2.56	2.55	2.54	2.54	2.40	2.46	2.52
PO Attainment Indirect	2.45	2.27	2.36	2.36	2.25	2.29	2.24	2.13	2.08	2.00	2.03	2.00	2.17	2.29
PO Attainment	2.47	2.43	2.43	2.37	2.38	2.37	2.40	2.47	2.46	2.43	2.44	2.32	2.40	2.47

Strategies for Slow, Average and Advanced Learners

For Slow learners

- Remedial classes
- Specially designed assignment/ task
- Student study group for peer-to-peer learning
- Individual Mentoring (Tutor Guardian)

For Medium Learners

- Additional assignment/ task
- Encouraging for timely and effective completion of work
- Conduction of quiz, orals etc.
- Solving previous year University question papers and test papers
- Presentation on technical topics/ case studies/mini projects

For Advanced Learners

- Encouraging to present & publish papers in journals/conferences/competitions
- Guidance for GATE/competitive Examination
- Encouraging to participate in professional activities.
- Specially designed activities to improve the portfolio of students.
- Individual guidance for career building

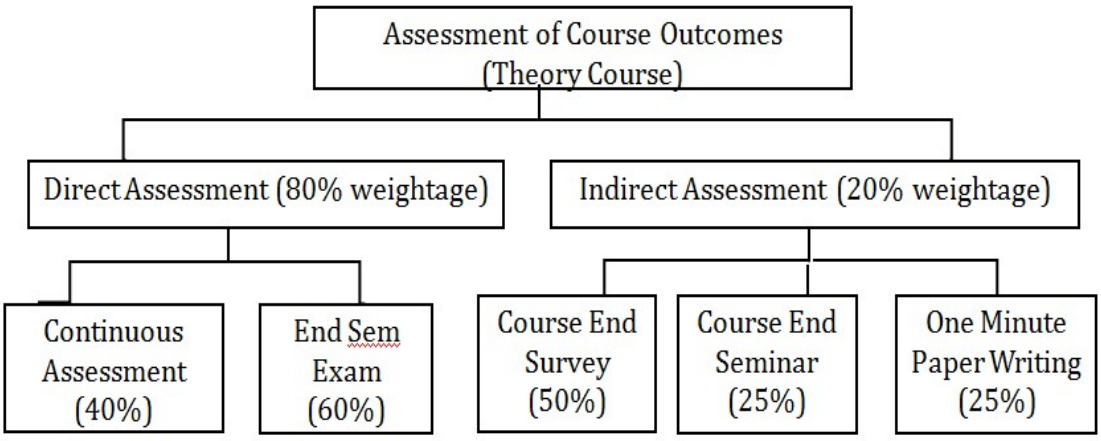
Step-by-Step Process for CO & PO Attainments

1. **Write Course Outcomes (COs) for each course of the program**
   - Write about 5-6 COs for each course using the action verbs of learning levels,
   - It should be narrower and measurable statements.
   - CO statements should describe what the students are expected to know and able to do at the end of each course, which are related to the skills, knowledge and behavior that students will acquire through the course.
   - Departmental Course Committees to finalize COs (Not individual faculty members)
2. **Mapping of CO's with PO's**
   - After CO statements are developed by the course in-charge, CO's should map with any possible PO's based on the relationship exist between them.
   - All PO's are not necessarily mapped with any one CO and it may be left blank.
   - All the courses together must cover all the POs (and PSOs). For a course we map the COs to POs through the CO-PO matrix and to PSOs through the CO-PSO matrix.
   - The CO-PO mapping has been done with correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The meaning of '-' is no correlation between CO and PO.
   - The Process for mapping the values for CO-PO Matrix is given in the Table below. It gives information about the action verbs used in the POs and the nature of POs, stating whether the POs are technical or non-technical, with an understanding of the intention of each PO and the Bloom's level to which each of these action verbs in the POs correlates to.

Table No 1 Process for mapping the values for CO-PO Matrix

<table>
<tr><th>Type</th><th>POs</th><th>PO action Verbs</th><th>POs Blooms Levels</th><th>COs Bloom's Level(s)</th></tr>
<tr><td rowspan="14">Technical Skills</td><td>PO1</td><td>Apply</td><td>L3</td><td rowspan="14">• Theory Courses: L1 & L4
• Laboratory courses: L1 to L5
• Mini Project and Major Project: L1 to L6
Thumb Rule for assigning mapping value
• If L1 Action Verbs of a CO Correlates with any of PO then assign mapping strength as '1'
• If L2 to L3 Action Verbs of a CO Correlates with any of PO then assign mapping level as '2'
• If L4 to L5 Action Verbs of a CO Correlates with any of PO then assign mapping level as '3'</td></tr>
<tr><td rowspan="3">PO2</td><td>Identify</td><td>L2</td></tr>
<tr><td>Formulate</td><td>L6</td></tr>
<tr><td>Review</td><td>L2</td></tr>
<tr><td rowspan="2">PO3</td><td>Design</td><td>L3,L6</td></tr>
<tr><td>Develop</td><td>L3,L6</td></tr>
<tr><td rowspan="3">PO4</td><td>Analyze</td><td>L4</td></tr>
<tr><td>Interpret</td><td>L2,L3</td></tr>
<tr><td>Design</td><td>L6</td></tr>
<tr><td rowspan="3">PO5</td><td>Create</td><td>L6</td></tr>
<tr><td>Select</td><td>L1,L2, L6</td></tr>
<tr><td>Apply</td><td>L3</td></tr>
<tr><td rowspan="2">PO6</td><td>Apply</td><td>L3</td></tr>
<tr><td>Assess</td><td>L5</td></tr>
<tr><td>Transferable Skills</td><td>PO7-12</td><td></td><td></td><td></td></tr>
</table>

3. **Assessment Process for CO Attainment (Theory Courses):**
   - Course Outcome is evaluated based on the performance of students in internal assessments, end semester examination of a course, course end seminar, one minute paper writing and feedback on course outcome.
   - Course end seminar, one minute paper writing and feedback on course outcome are the indirect measurement tools and internal assessments, end semester examination of a course are the direct method for CO assessment.
   - In direct assessment method, internal assessment (mid-term examinations, weekly quizzes and assignments are used for theory courses, rubrics based evaluation is used for seminar and projects courses) contributes 40% to the total CO attainment. End term assessment contributes 60% to the total attainment of a CO as shown in the flowchart below.



3.1 Assessment Process for CO Attainment : Direct method

- Every mid-exam question, every quiz question and every assignment is mapped to a specific CO.
- For practical courses, seminars and projects, rubrics should be mapped with every CO of that course.
- Thereafter, a CO wise cut-off value is taken based on the average marks scored by the students for that CO or a threshold mark such as 60% of the maximum marks allocated to that CO.
- The number of students with their marks in a CO under consideration, above the cutoff value is considered for the CO attainment.
- The documentation of the CO attainment level of the respective semester courses is presented in BoS meeting.

3.1.1 Sample calculation for CO1

- **In Mid semester exam**, if 10 students attempted for maximum 5 marks and out of which 7 students scored more than equal to threshold (i.e. 60% of 5 marks = 3 marks). Then % of students scoring >= internal threshold will be (7/10) * 100 = 70% .

- **For quiz and assignment part**, % of students scoring >= threshold in the above parts will be considered in same manner. Let i.e. 67.5% for quiz and 100% for assignment.
- **Similarly, for end semester examination, as each question is mapped with the CO, the number % of students scoring >= threshold can be obtained. Let for CO1,** if 10 students attempted for maximum 10 marks and out of which7 students scored more than equal to threshold (i.e. 60% of 10marks = 6 marks & above). Then % of students scoring >= internal threshold will be (7/10) * 100 = 70%.

$$\%\ CO\ Attainment = \frac{Number\ of\ students\ scored\ more\ than\ or\ equal\ to\ 60\%\ of\ Marks\ in\ CO_x}{Total\ Number\ of\ students} \times 100$$

Where x={1 to N}, N= number of course outcomes

3.1.2 Setting weightage for CO assessment (Direct method):

- 20% weightage is given to CO attainment based on mid semester examination
- 10% weightage is given to CO attainment based on online quiz.
- 10% weightage is given to CO attainment based on assignments
- 60% weightage is given to CO attainment based on end semester examination

- Based on the attainment level and the weightage assigned to the assessment tools, the % direct attainment of CO1 by all four parts is
  =.2*70%+.1*67.5%+.1*100%+.6*70%
  =72.75%
  Similarly, the attainment using direct assessment tools is computed for all other CO's.

3.1.3 Level of Attainment

- The % attainment is converted to level of attainments. The rubrics considered here are given below:
  - **Attainment Level 1: 50% of students score more than 60% marks out of the maximum relevant marks.**
  - **Attainment Level 2: 60% of students score more than 60% marks out of the maximum relevant marks.**
  - **Attainment Level 3: 70% of students score more than 60% marks out of the maximum relevant marks**
- So that attainment 72.75% is considered as attainment of level 3.

3.2 Assessment Process for CO Attainment (Theory Course) : Indirect Method

- Course end seminar and one minute paper writing is conducted as per the schedule mentioned prior in Time Table and the Institute Calendar.
- The evaluation team with class coordinator follow rubrics, which is set by the department for evaluation of course end seminar and marks are given to the students which are used for computation of CO attainments
- Also, the course exit survey (CO Feedback) is taken from all students on each CO.
- The course end seminar and one minute paper writing are given a weightage of 25% each and course end survey is given a weightage of 50%.

3.3 Overall CO Attainment:

- The Final CO attainment is calculated by combining the direct attainment and indirect attainment in a ratio of 80: 20 i.e
- **Overall Attainment of CO=80% Direct Attainment+20% Indirect Attainment.**
- Let the attainment of CO1 with indirect measurement tool is 2.6 and with direct measurement tool is 3.0. then
- **Overall Attainment of CO1=80% *3+20% *2.6=2.92**

3.4 If the average attainment of a particular course for two consecutive years is the maximum attainment value (i.e. level 3), then for that particular course the current rubrics for attainment must be changed to analyze continuous improvement.

4. **Assessment Process for CO Attainment (Laboratory Courses):**
   - For practical subjects, there is continuous internal evaluation during the semester for 60 marks and 40 marks for end semester viva voce.
   - In internal evaluation, rubrics are used for each experiment and marks are given.
   - At the end of the semester, all average of the marks assigned to each rubric criteria are taken as the final marks.
   - Each rubric is mapped with the course outcomes of the laboratory course.
   - The attainment is computed using the average marks and the number of students scoring >= threshold can be obtained.
   - % of CO attainment is obtained as

     = [(number of students scoring >= threshold) /No of student attempted] *100
   - 80% weightage is given to the continuous evaluation and 20% is based on the viva for internal assessment.
5. **Assessment Process for CO Attainment (Major Project):**
   - Project batches are formed as per the instruction given by project coordinators.
   - Synopsis will be submitted to the project coordinators for scrutinizing. Project Batches are allotted to the internal guides based on the specialization and competency skills of the faculties.
   - Each internal guide will continuously monitor their students on a weekly basis to observe the progress of the work.
   - The project guide along with project coordinator conduct 2(two) project reviews as per the rubrics, which is set by the Department.
   - The rubrics are mapped to CO and PO.
   - The Internal Assessment marks are used for used for computation of CO attainment.
   - External Project Viva voce is conducted by the panel of examiners.
   - Based on the viva voce the marks are awarded to the students the attainment is computed,
   - The overall CO attainment =50% internal assessment+50% external viva voce

The process of CO attainment is summarized as given in Figure 1 .

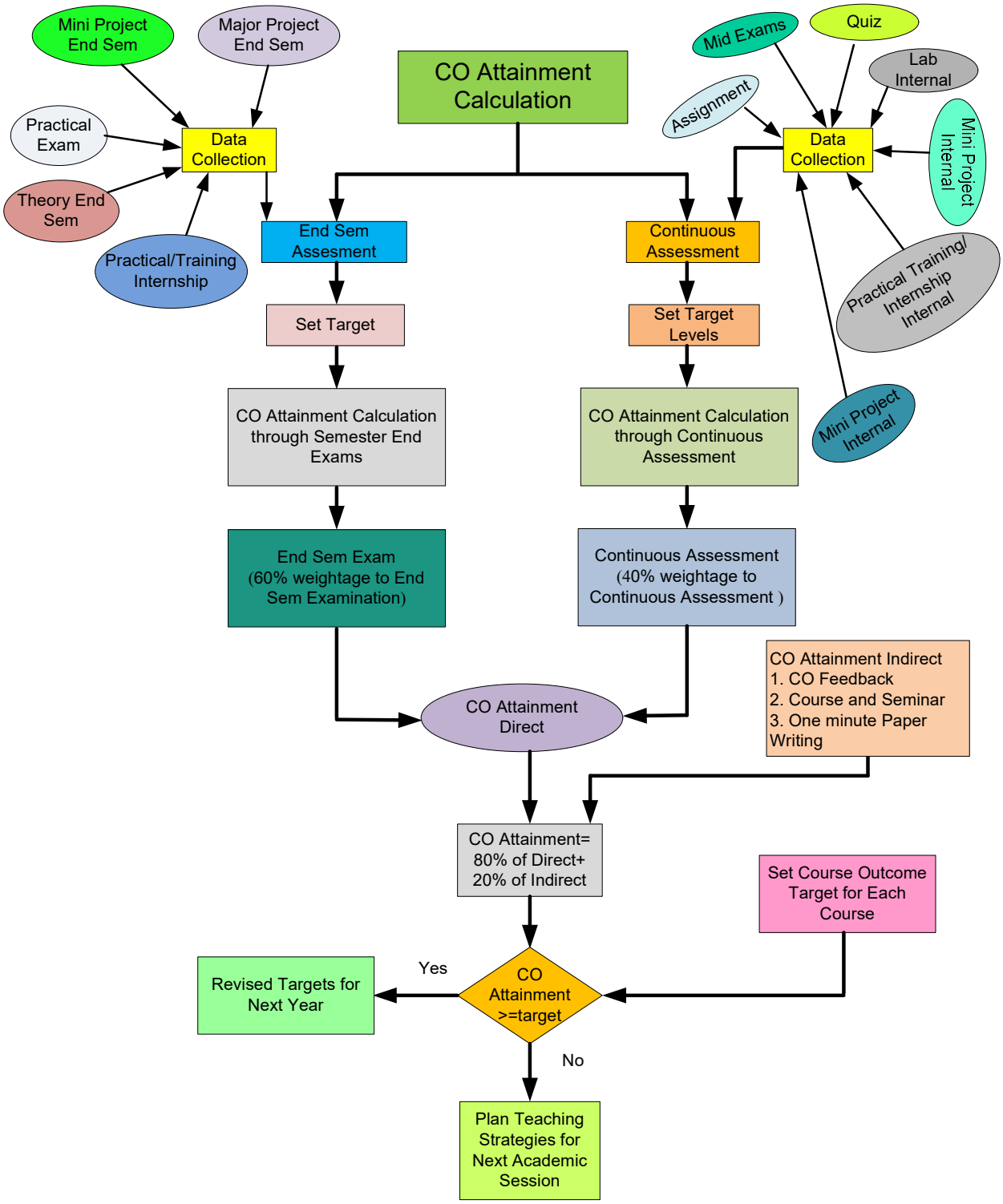


Figure 1 CO Attainment Calculation Process

6. PO Attainment

The process adopted for PO & PSO attainment is as shown in the flowchart below.

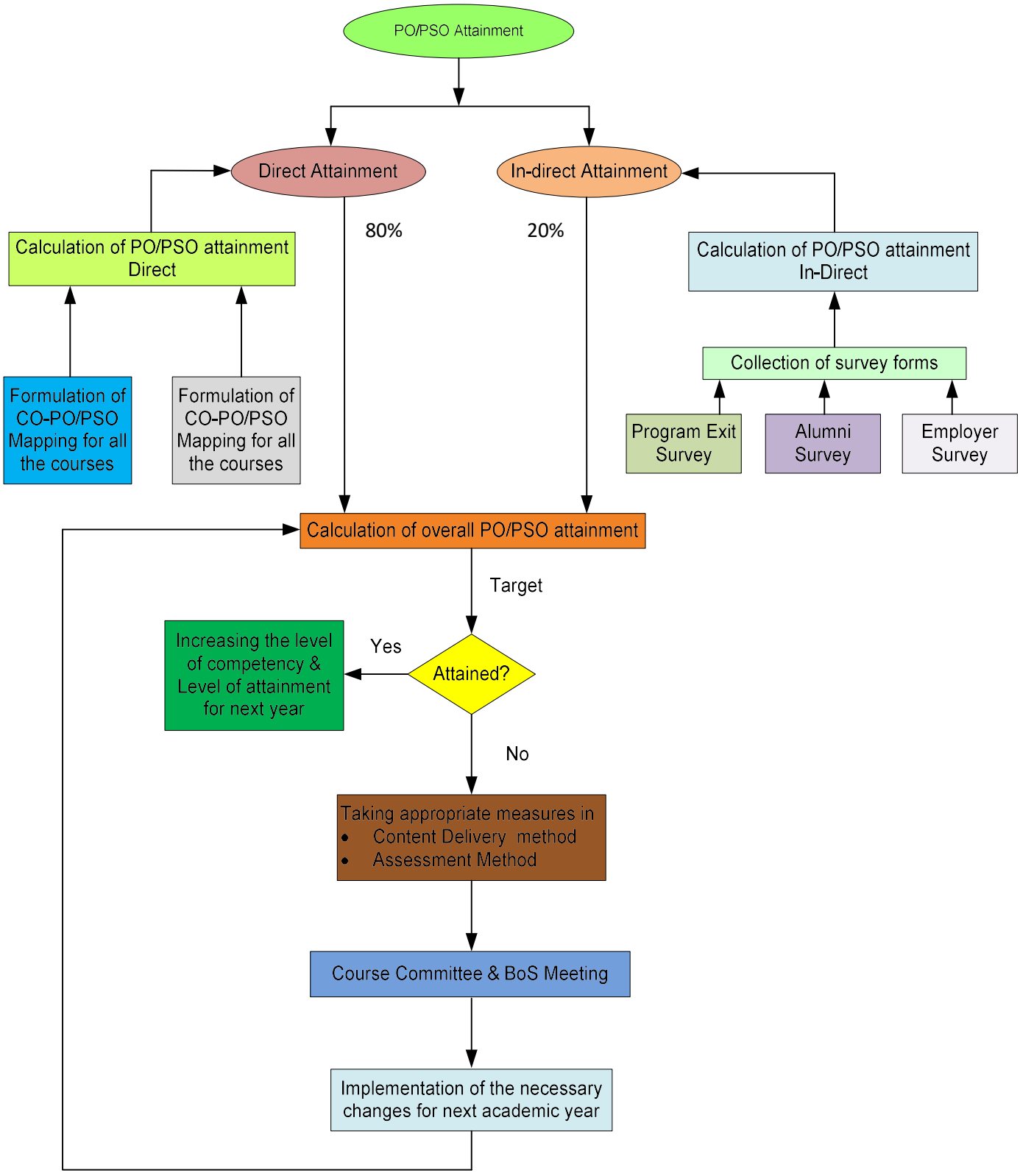


Figure 2. Process of PO/PSO Attainment

- PO/PSO assessment is done by giving 80% weightage to direct assessment and 20% weightage to indirect assessment.
- Direct assessment is based on CO attainment. At the end of the each programme, the PO/PSO assessment is done from the CO attainment of all curriculum components.
- Similarly, the values of PSO attainment are also determined

6.1 Direct Method

- The course outcomes are translated to POs**.**
- The each PO attainment of corresponding to a particular course is determined from the attainment values obtained for each course outcome related to that PO and the CO-PO mapping values.
- Initially, the attainment of each course outcome is determined using internal as well as external assessment.
- Question papers include, short answers, short essay and long essay type.
- In addition, MCQs examinations (quizzes) are conducted on each unit test. Assignments are given for each CO and on some extension of syllabus.
- In case of laboratory examination, experiment, viva voce, reports, etc., are the components.
- While setting a question paper, each question is framed based on the POs in order to attain them to a large extent.

6.2 Indirect method

- The indirect method done through surveys and interviews; it asks the stakeholders to reflect their views on student's learning.
- The institute assesses opinions or thoughts about graduate's knowledge or skills by different stakeholders.
- Program exit survey and employer survey are given a weightage of 25% each and alumni survey is given a weightage of 50%.

7. For weakly supported POs find the gaps, write additional COs, improve content delivery, modify curriculum, change evaluation methods etc.
8. The sample calculation of PO attainment is given below:

Course outcome

CO1	2.76
CO2	2.2
CO3	2.8
CO4	2.72
CO5	2.16
CO6	2.2

CO-PO Mapping

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
3	3	3	-	-	-	-	1	1	1	2	-	2	-
3	3	-	2	-	2	2	2	1	1	2	1	-	-
3	3	-	-	-	-	-	1	1	1	-	-	-	-
3	-	3	3	2	-	-	1	1	1	-	-	-	-
3	3	-	3	2	-	-	1	1	1	1	1	-	2
3	-	3	3	2	-	-	1	2	1	1	-	-	-

Sample Calculation:

Attainment of PO1

$$=(3\times2.76+3\times2.2+3\times2.8+3\times2.72+3\times2.16+3\times2.2)/(3+3+3+3+3+3)$$
$$=2.47$$

Attainment of PO5

$$=(2\times2.72+2\times2.16+2\times2.2)/(2+2+2)$$
$$=2.36$$

ANNEXURE I

(Sample: Curriculum-PO Mapping Matrix)

Annexure-1

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR-5

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

ELECTRICAL ENGINEERING DEPARTMENT

S.No.	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	BEEL301: Electrical Engineering Materials	X	X	X	X	X		X					X	X	
2	BEEL302: Measurement & Instrumentation	X	X	X	X	X	X		X	X	X	X	X	X	X
3	BEEL302: Measurement & Instrumentation (LAB)	X	X	X	X		X	X	X	X	X				X
4	BEEL303: Network Analysis	X	X	X	X	X	X	X	X	X	X		X	X	X
5	BEEL303: Network Analysis (LAB)	X	X	X	X		X	X	X	X	X				X
6	BEEL304: Analog Electronics	X	X	X	X		X			X				X	
7	BEEL304: Analog Electronics (LAB)							X	X	X	X	X	X		X
8	BEEL305: Electro Magnetic Field Theory	X	X	X						X				X	
9	BEEP306: Simulation Lab-I	X		X	X	X				X	X	X		X	X
10	BEEL307 : Idea Generation	X	X	X						X	X	X	X	X	X
11	BEEL308 : Communication Skills	X	X	X						X	X	X		X	
12	BEEL401: Mathematics-III	X	X	X	X	X		X					X	X	X
13	BEEL402: Electrical Machines-I	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	BEEL402: Electrical Machines-I (LAB)							X	X	X	X	X		X	
15	BEEL403: Digital Electronics & Microprocessor	X	X	X										X	
16	BEEL403: Digital Electronics & Microprocessor (LAB)						X	X	X					X	
17	BEEL404 : Linear Control Systems	X	X	X	X	X	X	X	X	X	X		X	X	X
18	BEEL404 : Linear Control Systems (Lab)					X	X	X		X	X	X	X	X	X
19	BEEL405: Signals & Systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Annexure-1

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR-5

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ELECTRICAL ENGINEERING DEPARTMENT

21	**BEEP406: Simulation Lab-II**	X			X	X							X	
20	**BEES407 GD/Seminar**	X	X	X	X	X	X	X	X	X	X		X	X	X
22	**BEES408:Integrated Ethics &Apititude**					X	X	X	X	X	X	X	X	X	X
32	**BEEL-501:PMME**						X		X	X	X	X		X	X
23	**BEEL503: Non-conventional Energy Resources**	X	X	X	X	X	X	X	X		X		X	X	X
24	**BEEL504: Control System Design**	X	X	X	X	X								X	X
25	**BEEL504: Control System Design Lab**														
26	**BEEL505: Transmission and Distribution**	X	X	X	X	X	X	X		X	X	X	X	X	X
27	**BEEL505: Transmission and Distribution (LAB)**	X	X	X	X	X	X	X		X	X	X	X		X
28	**BEEL506: Electrical Machines-II**	X	X	X	X			X	X			X		X	
29	**BEEL506: Electrical Machines-I(Lab)**	X	X	X	X	X	X	X	X	X	X	X	X	X	X
31	**BEEP507: Simulation Lab-III**	X			X	X				X	X	X		X	X
30	**BEES508/9 Self Study,Seminar& Group Discussion**	X	X	X						X	X	X	X	X	X
33	**BEEL602: Electric Machine -II**	X	X	X	X	X	X						X	X	X
34	**BEEL603: Power Electronics**	X	X	X		X	X				X				
35	**BEEL603: Power Electronics (Lab)**	X	X	X		X	X				X				
36	**BEEL604: Advanced Microprocessor and Interfacing**	X	X	X								X		X	
37	**BEEL605: Applied Instrumentation**	X	X	X		X	X							X	
38	**BEEL605 (LAB): Applied Instrumentation**								X	X	X	X	X		
39	**BEEL606: Power System Analysis and Control**	X	X	X	X	X	X	X		X	X	X	X	X	X

Annexure-1

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR-5

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ELECTRICAL ENGINEERING DEPARTMENT

40	**BEEL606 (LAB): Power System Analysis and Control**		X			X	X	X		X	X	X	X	X	X
41	**BEEL 607: Minor Project**	X	X	X					X	X	X	X		X	X
42	**BEES608/9 Self Study,Seminar& Group Discussion**									X	X			X	X
43	**BEEL-701: Electric Drives**	X	X	X	X	X	X	X		X	X	X	X		
50	**BEEL 701: Electrical Drives Lab**	X	X	X		X			X	X					X
44	**BEEL-702: Switchgear & protection**	X	X	X	X	X	X	X		X	X	X	X		
51	**BEEL 702: Switchgear & Protection Lab**	X	X	X		X									X
45	**BEEL703: Computer Aided Power System**	X	X	X	X	X	X						X	X	X
46	**BEEL704: Power System Economics**	X	X	X	X	X	X						X	X	X
47	**BEEL 705: Energy Audit & Management**	X	X	X	X	X	X							X	X
48	**BEEL706: Industrial Trainning& Internship**	X	X	X	X	X								X	X
49	**BEED707: Major Project I**	X	X	X					X	X	X	X		X	X
52	**BEES708 : Self Seminar & Group Discussion**									X	X			X	X
53	**BEEL 801: Soft Computing Techniues**	X			X	X	X			X		X	X		X
54	**BEEL 801: Soft Computing Techniues (Lab)**	X			X	X	X			X		X	X		X
55	**BEEL 802: Utilization of Electrical Energy**	X	X	X	X	X								X	X
56	**EEL803A: Process Instrumentation**	X	X	X	X									X	X
57	**BEEL804A: High Voltage Engineering**	X	X	X	X									X	X
58	**BEEL 805: Major Project**	X	X	X					X	X	X	X		X	X
59	**BEEL 806: Electrical Industrial Safety & Maintenance**	X	X	X					X	X	X	X		X	X

Annexure-1

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR-5

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

ELECTRICAL ENGINEERING DEPARTMENT

	Total courses	59													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
	Number of courses mapping the PO	**44**	**40**	**40**	**31**	**35**	**30**	**23**	**20**	**35**	**33**	**27**	**27**	**41**	**38**