

**Attainment of program outcomes,
program specific outcomes and
course outcomes**



UTKAL UNIVERSITY
Bhubaneswar 751004, Odisha

1. PREAMBLE

Being the mother university in Odisha, we at Utkal University thrives to become a premier university in India with a vision of offering several need-based, value-conscious and job-oriented quality educations to the students that cater to the need of the society at large. To this effect, the Choice Based Credit System (CBCS) is followed with the flexibility to innovate and design the course contents of each programme in line with the mission of the university. In order to have higher education with quality assurance, outcome-based education (OBE) are developed for each programme with a focus towards teaching, learning and assessment where the course contents are developed in terms of learning outcomes or course outcomes (CO). This idea makes a paradigm shift from the traditional teaching-learning process to OBE with a focus on continuous quality improvement (CQI) of the students at the end of the course or program. Accordingly, programme outcomes (PO) are defined and assessed by the faculty by mapping them into CO and taking appropriate steps for continuous improvement of the students and to improve their personal development and make them employable.

1.1. Programme Educational Objectives (PEOs):

PEOs are broad statements that describe the career and professional achievements that the programme is preparing the graduates to achieve within the first few years after graduation. PEOs should be consistent with the mission of the Institution. PEO's can be measured by a PO-PEO matrix. The PEOs should evolve through constant feedback from alumnae, students, industry, management etc, It is mandatory that each PEO should be mapped to at least one of the POs.

1.2. Programme Outcomes (PO):

Programme Outcomes are narrower statements that describe what students are expected to know and be able to do upon graduation. These relate to the skills, knowledge and behaviour that students acquire in their study through the programmes.

1.3. Course Outcomes (CO):

Course Outcomes are narrower statements that describe what students are expected to know and be able to do at the end of each course. These relate to the

skills, knowledge, and behaviour that students acquire in their study through the course. Each course comprises five COs and the keywords used to define COs are based on Bloom's Taxonomy.

1.4. BLOOM'S TAXONOMY:

Bloom's Taxonomy was created in 1956 by an educational psychologist Dr. Benjamin Bloom in order to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts. It is most often used when designing educational, training, and learning processes, which is shown in Figure 1.

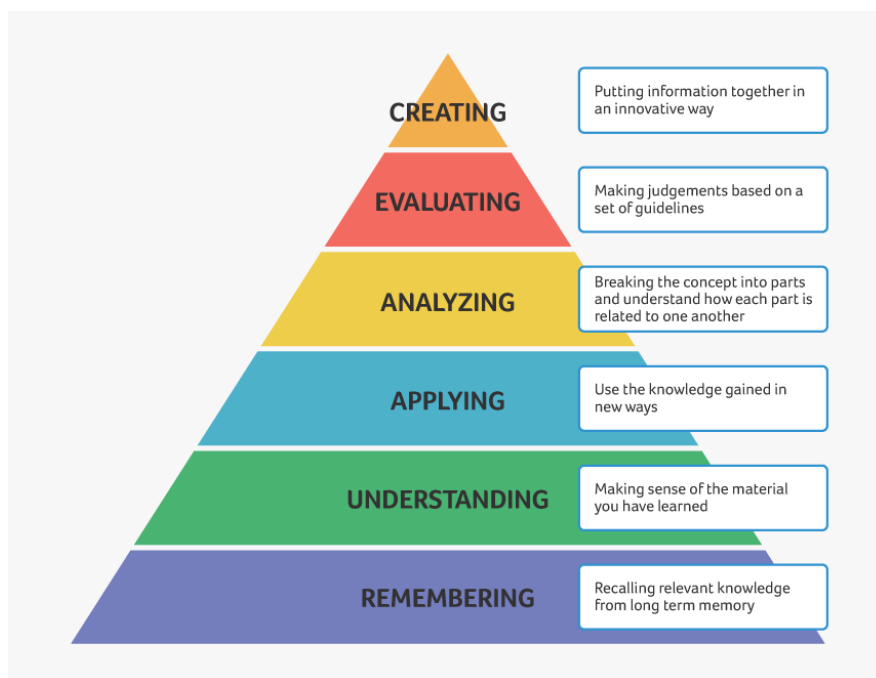


Figure 1: Bloom's Taxonomy

These 6 levels are used to structure the learning outcomes, lessons, and assessments of the course. :

1. **Remembering:** Recall facts, terms and basic concepts of the subject / Course by memorizing, listening, bookmarking, bullet-pointing etc.
2. **Understanding:** Constructing meaning from oral, written, and graphic messages through interpreting, expressing, exemplifying, annotating, summarizing, demonstrating, discovering, comparing, classifying etc.

3. **Applying:** Usage of learned materials in developing model, executing, or implementing, applying methods, solve the problem, interpret, illustrate, show, sketch etc.
4. **Analysing:** Experiment, analyse, the model created through outline, calculate, differentiating, organizing, inspect, test, criticize, diagram and relate.
5. **Evaluating:** Making judgments based on criteria and standards through evaluate, judge, revise, justify, recommend and conclude.
6. **Creating:** Compose all elements to form a coherent or functional whole; reorganizing elements into a new pattern or structure through rearrange, manage, setup, construct, formulate and assemble.

1.5. CO – PO MAPPING OF COURSES:

After CO statements are developed by the course in charge, COs will be mapped with any possible POs based on the relationship that exists between them. A CO must be mapped to at least one PO. The PO's which are not related to any of the COs in a particular course may be left blank. All the courses together must cover all the POs. The mapping between COs and PO can be defined by three levels using the Letter Grades H, A, L which denote respectively High (H), Average (A), and Low (L) correlation and accordingly points are earmarked as 3,2,1 respectively.

2. MEASUREMENT OF ATTAINMENT OF DESIRED GOALS:

Course Outcome (CO) is measured through the performance of students by the various assessment tools adopted for that particular course. Each evaluation tool is mapped to a particular verb in Bloom's Taxonomy and further, each verb is mapped to a particular CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix. Measurement of PO attainment shall be done by direct and indirect methods. Direct assessments (rubric based) - Conventional assessment tools such as Term Tests (20%), Quizzes, Seminars and Assignment together (10%) and End Semester Examinations (70%) with specified weightages are used for CO-PO mapping and to find out the attainment level. Indirect assessments such as feedback from students, Alumnae, employers and Parents are used to improve the syllabus for better quality education to meet societal and industrial needs. The target level of attainment shall be fixed by the Course teacher and the teacher's council of respective departments.

2.1. PROCESS INVOLVED IN CO DEFINING AND CO-PO MAPPING:

Assessment of COs, POs and PSOs is a core academic activity and highly essential to assess the learning ability of the student. Programme outcome assessment is a continuous process to support teaching, learning and evaluation. It is the main mechanism to monitor the effectiveness of the learning environment based on evidences that determine whether students have met the course outcomes and objectives.

- Curriculum development includes description of Course Outcomes and Mapping of COs with POs.
- Program Curriculum along with COs & POs included in Syllabus will be approved in BoS & AC.
- There is a well-defined process for attainment of COs & POs in the University.
- During the execution if any gaps were identified then necessary action will be enforced by the departmental level committee with the support of BoS & AC.
- These Departmental- Level Committees will set the target both COs & POs prior to the commencement of the semester keeping in the view of earlier batch attainments and Current batch pass percentage.
- Course coordinators have been given with free hand in the designing of COs and mapping of COS with POs, and the assessment tools with rubrics will be defined by the course coordinator with the due approval of departmental committee.
- The direct assessment of POs is defined as cumulative assessment of Cos.
- Indirect Assessment involves the qualitative method of obtaining the reflections of the stakeholders like Students, Alumni, Faculty, Employers, Parents and Experts on the achievement of the program outcomes, through feedback mechanism.
- CO-PO mapping will be done by respective subject experts during the preparation of curriculum. The CO-PO mapping will be verified and or modified by respective senior faculty along with other faculties handling the same subject before the commencement of class work. The CO-PO mapping will be approved by DAC. Model of Cos-POs is be as follows in Fig No 1.1.

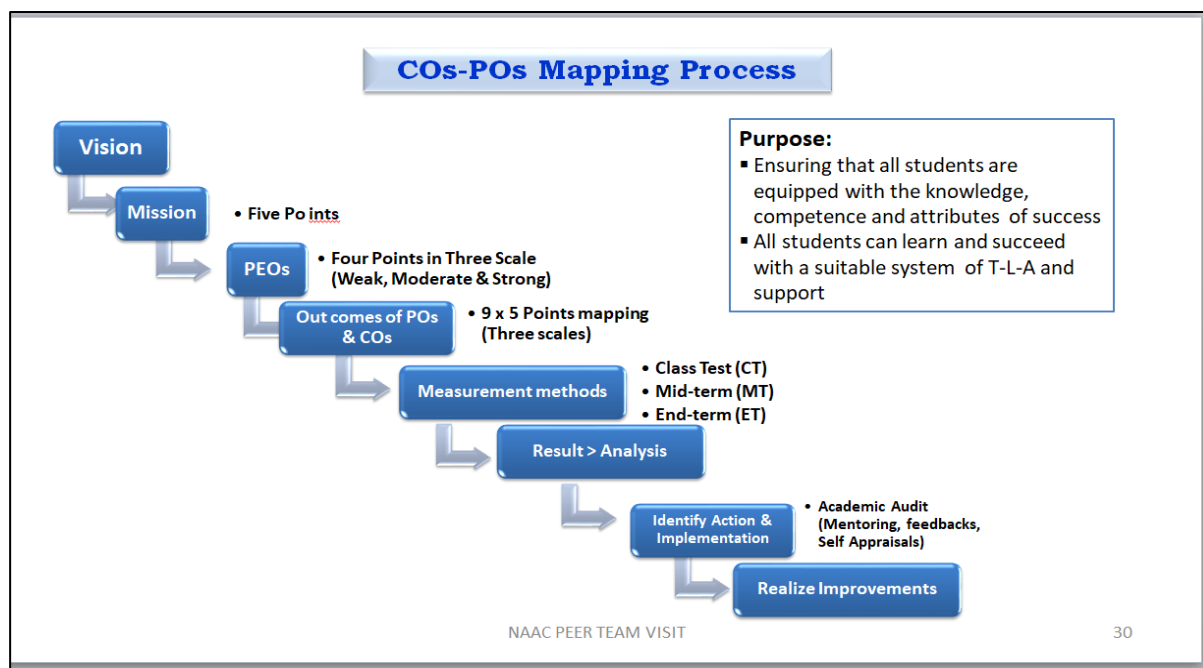


Fig No 1.1.: Cos-POs mapping Process

3. ASSESSMENT PROCESS IN PRACTICE:

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of course outcomes and programme outcomes. Its purpose is of (a) ensuring that all students are equipped with the knowledge, competence and attributes of success; (b) All students can learn and succeed with a suitable system of T-L-A and support.

3.1. Assessment Process for CO Attainment:

The role of CO-PO mapping will be assigned to the faculty. Since the department is having more than one section in a year, after the course (subject) allotment from the department, the senior faculty (subject expert) will be nominated as Programme coordinator of the corresponding course. The course coordinator (senior faculty) of the course along with other faculties (who handle the same subject) has to verify/modify appropriate COs for their corresponding Programme. It should be narrower and measurable statements. By using the Bloom's Taxonomy levels, CO's will be designed. 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 behaviour that students will acquire through the course. After writing the CO statements, CO will be mapped with PO. The role of the Programme

coordinator is to review the CO statements and the CO-PO mapping which has been done in association by course in-charges. The program coordinator has to consolidate the CO attainment level and PO attainment level of individual course at the end of the semester. For the evaluation and assessment of CO's and PO's, rubrics are used.

3.2. Course Articulation Matrix

Course correlation matrix shows the learning relationship (Level of Learning Achieved) between Course Outcomes and Program Outcomes of a course. This matrix strongly indicates whether the students are able to achieve the course objectives/outcomes. The matrix can be used for any course and is a good way to evaluate a course syllabus/content/structure. All the courses together must cover all the POs (and PEOs). For a course we map the COs to POs and PEOs through the CO-PO-PEO matrix. The various correlation levels in the matrix are as shown below.

“1” – Slight (Low) Correlation,

“2” – Moderate (Medium) Correlation,

“3” – Substantial (High) Correlation

As an instance, the description of Course MLIS-402 are as follows:

MLIS-402: RESEARCH METHODOLOGY & STATISTICAL TECHNIQUES	
CO-1	Have a fundamental understanding of the basic concepts of Library Administration.
CO-2	Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge presentation, and learning.
CO-3	Have a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
CO-4	Have knowledge of the current scope and limitations, and societal implications of AI.
CO-5	Have a basic foundation in machine learning.

(i) CO Assessment Rubrics:

Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments, Assignment & Quiz and in End Semester Examination of a course

(ii) CO Assessment Tools:

- For Theory: One mid-term examination of one hour duration is conducted with 20% credit, at-least one assignment and quiz are given for each course with 10% credit and finally students appear the end-term examinations after completion of the course of three hour duration with a credit of 70%.
- For the theory courses, evaluations of course outcomes (CO) are then carried out. The questions in the Mid-Term Test, Quiz and Assignment are framed in such a way that they cover all the COs of respective course. The final attainment for each CO under direct assessment is calculated by taking average of the CO attainments from Mid-Term Test, Assignment and Quiz. End-term examination covers the entire syllabus of the course and generally satisfies all course outcomes for a particular course. The COs are then evaluated based on the set attainment levels. For all these assessment tools, all POs are to be mapped with Cos to obtain the final attainment levels.

The step by step process for assessing course outcomes is:

Step 1: The Course coordinator analyses each course outcome into elements (different abilities specified in the outcome) and a set of attributes defined for each element (actions that explicitly demonstrate mastery of the abilities specified).

Step 2: Identify/select courses syllabus that address the outcome (each unit in syllabus contributes to at least one of the outcomes).

Step 3: For each course outcome, define performance indicators (Assessment criteria) and their targets.

Step 4: The Programme coordinator collects the qualitative and quantitative data and analyse the collected data and assessed the level of data meets the performance targets.

Step 5: The department advisory board (Consist of HoD, Senior faculty and Coordinator) recommends content delivery methods/ course outcomes/curriculum improvements as needed.

(iii) CO Attainment:

- Direct CO Attainment: Course outcomes of all courses are assessed and the CO wise marks obtained by all the students are recorded for all the assessment tools mentioned above. The respective CO attainment level is evaluated based on set attainment rubrics.

Level-1: percentage of students who secures less than 60% of the total marks

Level-2: percentage of students who secures between 60% to 70% of the marks

Level-3: percentage of students who secures more than 70% of the marks

- Target setting for Assessment method:

The marks by the students at the current semester as mentioned above can be kept as a target.

- The formula used for calculating the Attainment for each CO:

Attainment = Percentage of students who have scored more than the target marks

(iv) Direct Attainment of POs:

The POs are purely technical in nature, while the other POs are transferable skills. POs of University are to be calculated by a 9 Articulation Matrix across the programme, irrespective of their discipline such as:

POs	
PO-1	Discipline Knowledge & Expertise
PO-2	Contextually Innovate
PO-3	Civic Engagement
PO-4	Professionalism and Leadership
PO-5	Research and Enquiry
PO-6	Socially inclusive and responsible
PO-7	Professional Ethics & Sensitivity
PO-8	Team Work & Communication skills
PO-9	Lifelong Learning

- Direct Attainment of POs are then computed for all Courses at the end of each programme through the direct PO assessment is done from the CO attainment of all courses. The direct PO attainment for a particular course is determined from the attainment values obtained for each course outcome related to that PO and the CO-PO mapping values. For the evaluation and assessment of CO's and PO's, the same set of rubrics is used. As an instance, the PO-CO matrix indicating PO attainment will be done as the way follows:

PO-CO MATRIX INDICATING PO ATTAINMENT										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
CO1	3	3	3	3	3	3	3	3	2	
CO2	2	2	2	2	2	2	2	2	3	
CO3	3	3	2	3	2	2	2	3	3	
CO4	3	2	3	3	2	2	1	3	2	
CO5	2	2	2	2	1	3	2	2	3	Average
Overall Mapping of the Subject	2.6	2.4	2.4	2.6	2	2.4	2	2.6	2.6	2.40
PO Attainment (Overall attainment of the subject)	2.85	2.83	2.83	2.85	2.90	2.75	2.70	2.62	2.62	2.77
FORMULA USED	$PO1=(2.00*3+1.85*2+2.08*3+2.03*3+1.97*2)/(3+2+3+3+2)$									

Example Scenario:

CO3: Have a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.

Assessment:/ASIGNMENT/ Design a 5-3-3-1 multilayer feed-forward neural network with learning rate be 0.9. The initial weight and bias values are given along with first training tuple, $X=(1,0,1)$ whose class label is 1. Calculate the error backpropagation along with weight and bias update.

Is CO reflects the intended measurement from PO1, PO 2, PO3?

Remarks: CO3 – PO1, PO 2, PO3

Does the assessment correlates well with the CO?

Mapping analysis adopted:

In this case, students are expected to identify and formulate various design parameters of this latest technique (Artificial neural network) in terms of number of hidden layers apart from input and output layer followed by understanding the number of neurons to be present in each of these layers as per problem specified. They are also required to look for specifications as per the ANN algorithm and then apply the error backpropagation principles to arrive at solutions.

This assessment correlates well with the CO and hence maps strongly for PO1, PO2 and PO3.

(v) Assessment Process For Programme Educational Objectives:

The curriculum is designed so that all courses contribute to the achievement of PEOs. The marks secured by the students in these courses indicate the level of achievement of the PEOs. In addition, Alumnae survey, Placements of students and progression to higher studies also contribute to the attainment of PEOs. The same rubrics are used for calculating the attainment level.

(vi) CO–PO and CO–PEO Mapping Of Courses

The assessment takes place at following levels: a) The Course-level Assessment, b) The Programme level assessment. The CO attainment levels are measured based on the results of the cumulative internal examinations and semester end examination conducted by the university. This is a form of direct measurement of attainment.

* The Tools for assessment marks for internal and external examinations will follow the details of guidelines and manual of Utkal University and its revision and or updating from time to time.

4. DIRECT ATTAINMENT METHOD OF PO/PEO

The attainment of PO/PEOs process requires the attainment of COs and CO-PO-PEO mapping table (Course articulation matrix) for the course. The following table 3 shows the tools and process for direct PO attainment.

PO Attainment	Tools	Process
Direct CO Attainments	Internal Assessment Test <ul style="list-style-type: none"> • Assignments • Tutorials • Online Quiz • University Examination 	<ul style="list-style-type: none"> • Assignments / Tutorials / online quizzes are given periodically for the entire course to attain the specific POs. • Three Internal Assessment Tests are conducted per semester to evaluate the student performance. • University Examination is conducted once in a semester as per Anna University Schedule
	Performance Viva Voce Record Presentation Group Discussion	<ul style="list-style-type: none"> • Student Contribution in laboratory is evaluated based on the performance, Viva Voce, Presentation and Record Work. • Model Practical examination is conducted for 100 marks for a duration of 3 hours. • University Examination is conducted once in a semester as per Anna University Schedule
	Project Reviews	<ul style="list-style-type: none"> • Students are divided into batches. Each batch consists of three to four students. • Supervisors are allotted for each group. • Zeroth reviews are conducted for the students to identify the area of project. • Three reviews are conducted periodically to monitor and evaluate the progress of the project. • Viva-Voce is conducted at the end of the semester .

Course level PO & PEO Attainment Calculation

$$CO \text{ Attainment Ratio of Course}(x) = \frac{CO \text{ Attainment of Course}(x)}{3(\text{Maximum attainment Value})}$$

Where, x= [1 to N], N= Number of Courses

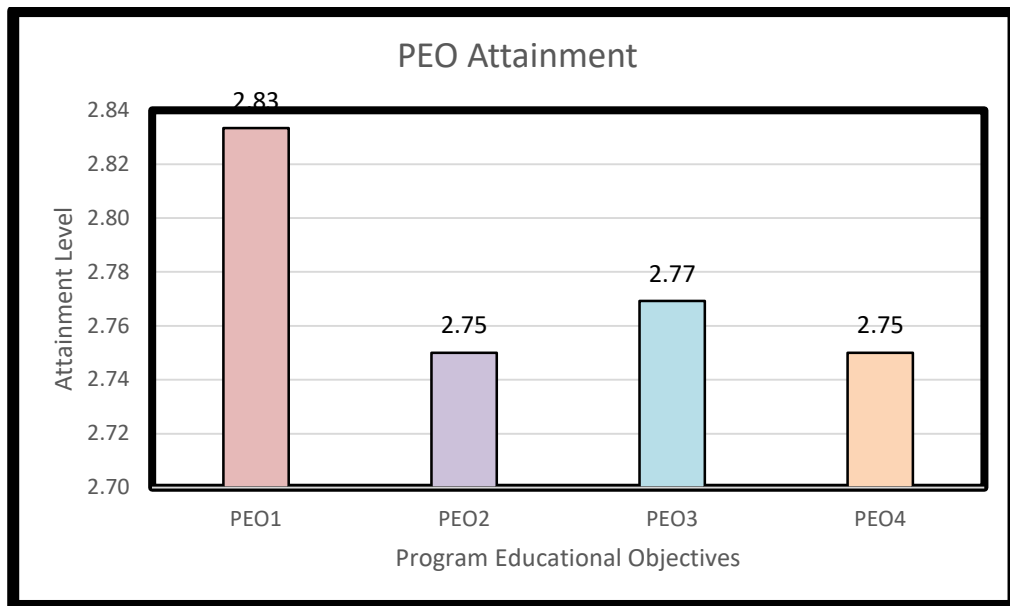
$$POm \text{ Attainment of course}(x) = CO \text{ Attainment Ratio of Course}(x) \times POm \text{ Mapping Value of Course}(x)$$

The PO & PEO attainment for the course is calculated using the following formula.

The CO attainment of a course and its CO-PO-PEO mapping tables are given below:

PEO-CO MATRIX INDICATING PEO ATTAINMENT					
	PEO1	PEO2	PEO3	PEO4	
C01	3	3	2	3	
C02	3	1	3	3	
C03	3	3	3	2	
C04	1	2	2	1	
C05	2	3	3	3	Average
Overall Mapping of the PEO	2.40	2.40	2.60	2.40	2.45
PEO Attainment	2.83	2.75	2.77	2.75	2.78
FORMULA USED					
PEO1=(2.00*3+1.85*3+2.08*3+2.03*1+1.97*2)/(3+3+3+1+2)					

Indirect Assessment involves the qualitative method of obtaining the reflections of the stakeholders on the achievement of the program outcomes, through feedback mechanism. These methods provide clues about what could be assessed directly easy to administer particularly useful for ascertaining values and beliefs. The PEO attainment will be as follows:



5. IDENTIFICATION OF ATTAINMENT GAPS AND PRACTICES TO IMPROVE:

To improve the PO and PEOs, We used the following activities –

- Academic activities
- Professional activities Academic activities enforced to improve the attainment of PO and PEOs from In addition to the teaching and learning practices, the following are adopted.
- Increase in the attendance cut off
- Introduction of Periodic Assignments
- Introduction of Continuous Laboratory Assessment in Laboratory Courses.
- Professional activities enforced to improve the attainment of POs and PEOs
- Effective Counselling and mentoring