

ADITYA ENGINEERING COLLEGE

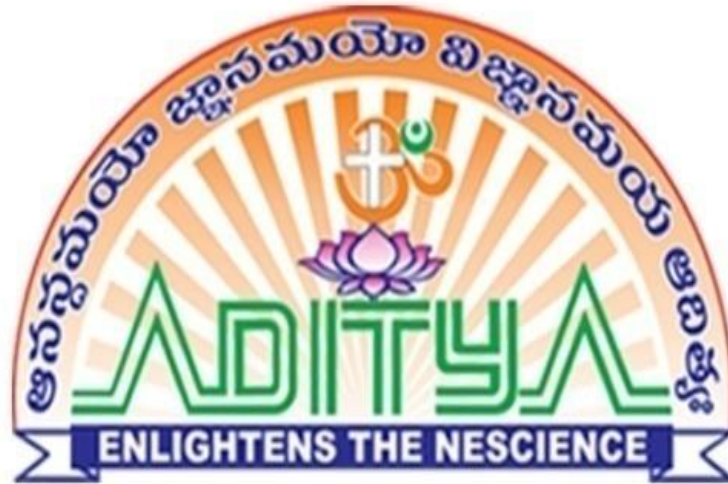
(An Autonomous Institution)

Approved by AICTE, Permanently Affiliated to JNTUK & Accredited by NAAC with 'A' Grade

Recognized by UGC under the sections 2(f) and 12(B) of UGC act 1956

Aditya Nagar, ADB Road, Surampalem - 533 437

OUTCOME BASED EDUCATION (OBE) MANUAL



Index

1 OUTCOME BASED EDUCATION(OBE) FRAMEWORK

- 1.1 Fundamentals of Outcome Based Education (OBE)
- 1.2 Bloom's Taxonomy
- 1.3 OBE Awareness to Learners & Instructors as a Part of Teaching-Learning Process
- 1.4 Vision –Mission
- 1.5 Program Outcomes (PO)
- 1.6 Program Specific Outcomes (PSOs)
- 1.7 Program Educational Objectives (PEOs)
- 1.8 Role of OBE Process in Curriculum Development and Implementation
- 1.9 Course Outcomes (COs) Attainment
- 1.10 Program Outcome (PO) & Program Specific Outcome (PSO) Attainment
- 1.11 Bridging the CO Attainment Gap
- 1.12 Bridging the PO/PSO Attainment Gap

2 PROCESSES FOR OBE COMPONENTS

- 2.1 Framing Vision, Mission, Program Educational Objectives, Program Outcomes and Program Specific Outcomes
- 2.2 Guidelines for writing Course Outcomes
- 2.3 Process of Curriculum Design
- 2.4 Process of CO-PO-PSO Attainment Calculation
- 2.5 Process for Program Outcome (PO) & Program Specific Outcome (PSO) Attainment
- 2.6 Bridging the CO Attainment Gap
- 2.7 Bridging the PO/PSO Attainment Gap

3 EXAMPLES

- 3.1 Vision-Mission of the Institute and Departments
- 3.2 Program Outcomes(PO's)
- 3.3 Program Specific Outcomes(PSO's)
- 3.4 Program Educational Objectives (PEO's)
- 3.5 Course Outcomes(COs)
- 3.6 Calculation of CO Attainment for a Theory Course
- 3.7 Bridging the CO Attainment Gap
- 3.8 Complete PO/PSO Attainment Calculation
- 3.9 Bridging the PO/PSO Attainment Gap

PREFACE

Outcome Based Education (OBE) Manual is to make the users aware of the OBE process which is being followed in Aditya Engineering College (A), Surampalem since 2017. All the stakeholders of the institute will be made aware of all the phases of OBE process, designed and implemented.

The present manuscript provides all corners of this OBE process i.e., design stage, training stage and implementation stage for the benefits of students and faculty of the institute. All the stakeholders of the institute i.e., students, parents, alumni etc. shall be made aware of the completed process and applications of OBE i.e., curriculum design and development, upgradation of teaching-learning process, design and implementation of assessment procedures.

OBE manual comprises of three (3) chapters in which the fundamentals of OBE framework are covered in Chapter 1, processes of OBE are covered in Chapter 2 and examples of the processes are covered in Chapter 3.

CHAPTER 1

OUTCOME BASED EDUCATION (OBE) FRAMEWORK

1.1 FUNDAMENTALS OF OUTCOME BASED EDUCATION (OBE)

Fundamental concepts of the Outcome Based Education are as under:

Course is defined as a theory or a practical or a theory cum practical subject studied in a semester.
Ex: Engineering Mathematics

Program is defined as the specialization or discipline of a degree. It is the interconnected arrangement of courses, co-curricular and extracurricular activities etc. to accomplish predetermined objectives, thus leading to the awarding of a degree. For example: B.E., Marine Engineering

Course Outcomes (CO)

Course outcomes are those which statements that describe significant and essential learning that learners have achieved, and can be reliably demonstrated at the end of a course. Generally 5 or 6 course outcomes are specified for each a course based on its weightage.

Program Outcomes (PO)

Program outcomes are narrow statements that describe what students are expected to be able to do by the time of graduation.

GENESIS OF OUTCOME BASED EDUCATION (OBE)

It is a process that involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of higher order learning and mastery rather than the accumulation of course credits.

WASHINGTON ACCORD

It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering

The induction of India in the Washington Accord in 2014 with the permanent signatory status of The National Board of Accreditation (NBA) is considered a big leap forward for the higher education system in India. It means that an Engineering graduate from India can be employed in any of the other countries who have signed the accord. For Indian Engineering institutions to get accredited by NBA according to the pacts of the accord, it is compulsory that engineering institutions follow the Outcome Based Education (OBE) model.

Outcome-Based Education (OBE) model is being adopted in engineering colleges now-a-days as per AICTE guidelines. This model is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes. Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behaviour, a graduate is expected to attain upon completion of a program after 4 – 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular engineering degree are predetermined and the students are evaluated for all the required parameters (outcomes) during the course of the program. Accreditation is mandatory for any institution in view of Global recognition. The OBE framework and Outcome Based Accreditation are shown in Fig 1.1 and Fig. 1.2.

The OBE Framework

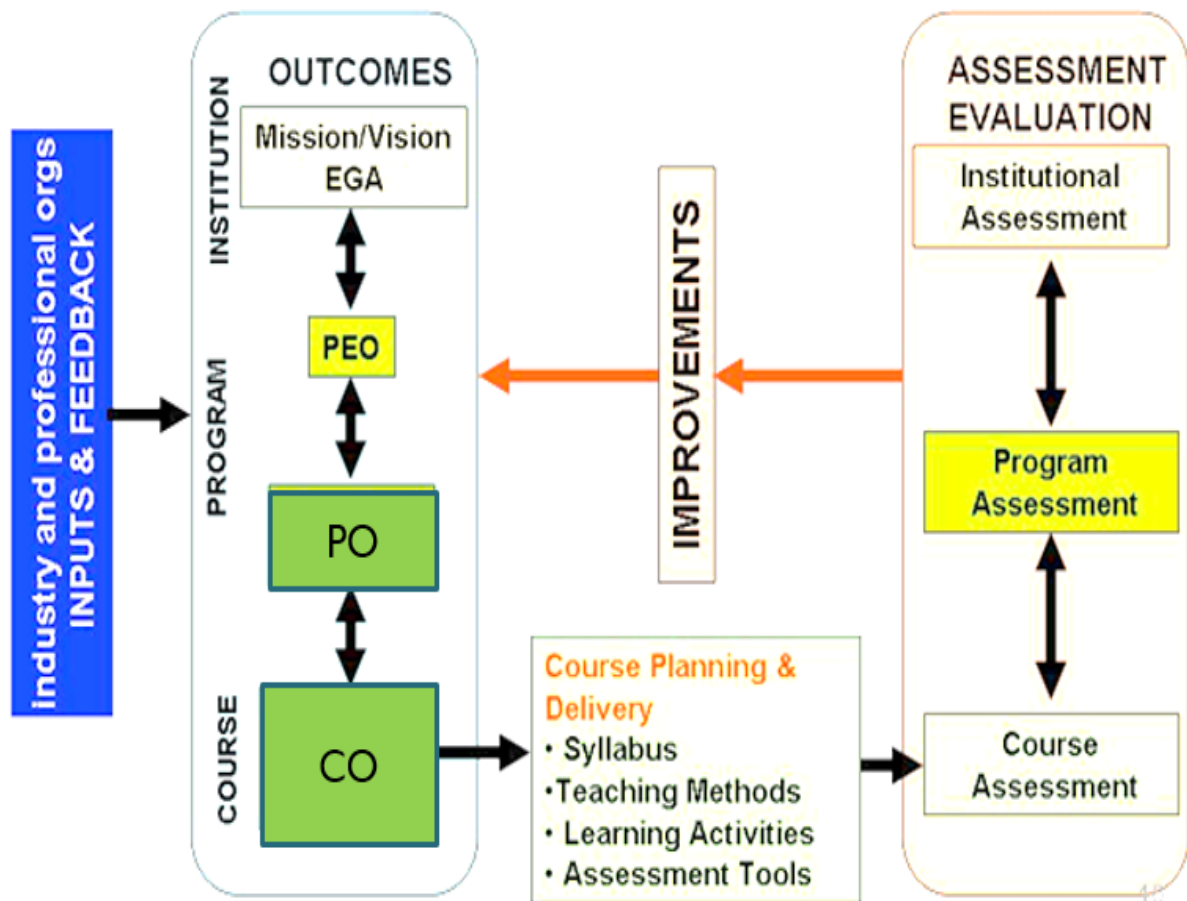
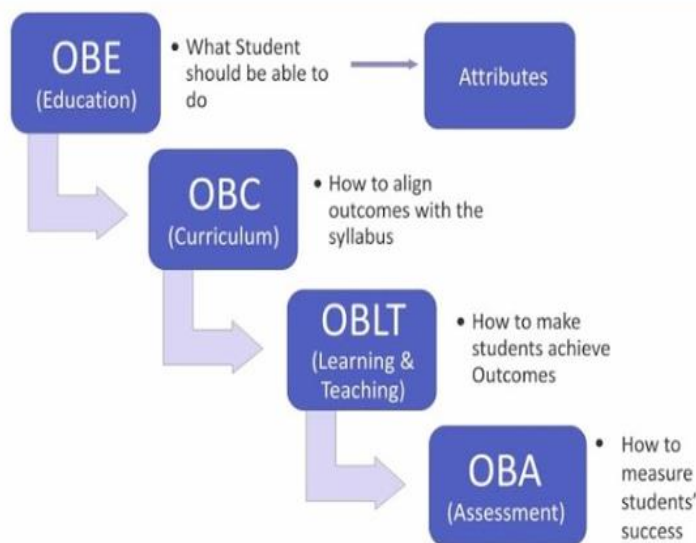


Fig. 1.1: OBE Framework

Outcome Based Accreditation



Reference : NBA India- Learning Resources

Fig. 1.2: OBE Accreditation

TRADITIONAL EDUCATION Vs OUTCOME BASED EDUCATION

The difference between traditional education and outcome based education lies in the approach through various parameters i.e., role of a teacher, focus on the teaching-learning process, output in measurable terms etc. All the comparative parameters are shown in Fig 1.3 and Table 1.1.

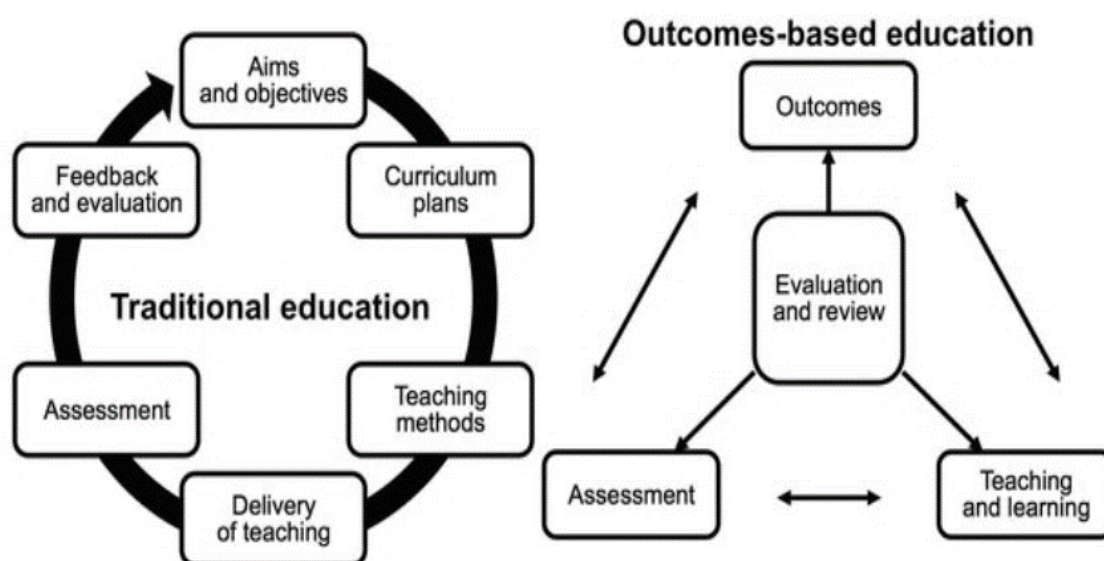


Fig. 1.3: Traditional Education Vs Outcome Based Education

**Table 1.1: Traditional Teaching Approach
Vs
Outcome Based Approach**

Traditional Teaching Approach	Outcome Based Approach
Teacher-centered	Learner/Student centered
Teacher's role as instructor	Teacher's role as partner /facilitator
Focus on Teacher's input	Focus on learner's output
Rigid and Controlling	Flexible and empowering
Emphasis on products	Emphasis on progress and overall learning
Course objectives / Syllabus is seen rigid and non-negotiable	Learning outcomes / Learning programmes are seen as guides that allows teachers to be innovative and creative in achieving learning outcomes
Norm-referenced assessment	Criterion reference assessment
Content based and content delivery	Ability building and Skills development

Spady, W. D, in his book, “Outcomes Based Education: Critical Issues and Answers” highlighted the following seven beliefs and features as:

- 1 All students can learn and succeed, but not on the same day in the same way.
- 2 Success breeds success.
- 3 Schools control the conditions of success
- 4 It emphasizes authentic, achievable and assessable learning outcomes
- 5 It is primarily concerned with what students' culminating capabilities at graduation time. It centers curriculum and assessment design around higher order exit outcomes
- 6 It is accountable to the stake holders, the learners, the teachers, the employers and the public
- 7 It leads to the change of schooling, including the curriculum, instruction and assessment

The fundamental phase of Outcome based educations starts from identifying the different levels of learning, which is easily identifiable using Blooms' Taxonomy which will be explained in the next section 1.2.

1.2 BLOOM'S TAXONOMY

Bloom's Taxonomy provides an important framework to not only design curriculum and teaching methodologies but also to design appropriate examination questions belonging to various cognitive levels. Bloom's Taxonomy of Educational Objectives developed in 1956 by Benjamin Bloom was widely accepted by educators for curriculum design and assessment.

In 2001, Anderson and Krathwohl modified Bloom's Taxonomy to make it relevant to the present-day requirements. It attempts to divide learning into three types of domains (cognitive, affective and behavioural) and then defines the level of performance for each domain. Conscious efforts to map the curriculum and assessment to these levels can help the programs to aim for higher-level abilities which go beyond remembering or understanding, and require application, analysis, evaluation or creation.

Revised Bloom's taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge. It is popular framework in engineering education to structure the assessment as it characterizes complexity and higher-order abilities. It identifies six levels of competencies within the cognitive domain which are appropriate for the purposes of engineering educators. Bloom's Taxonomy is hierarchical, meaning that learning at the higher level requires those skills which are attained at a lower level.

Action verbs for Assessment

Choice of action verbs in constructing assessment questions is important to consider. Quite often, the action verbs are indicators of the complexity (level) of the question. Over the time, educators have come up with taxonomy of measurable verbs corresponding to each of the Bloom's cognitive levels. These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level we are trying to assess.

Bloom's Taxonomy

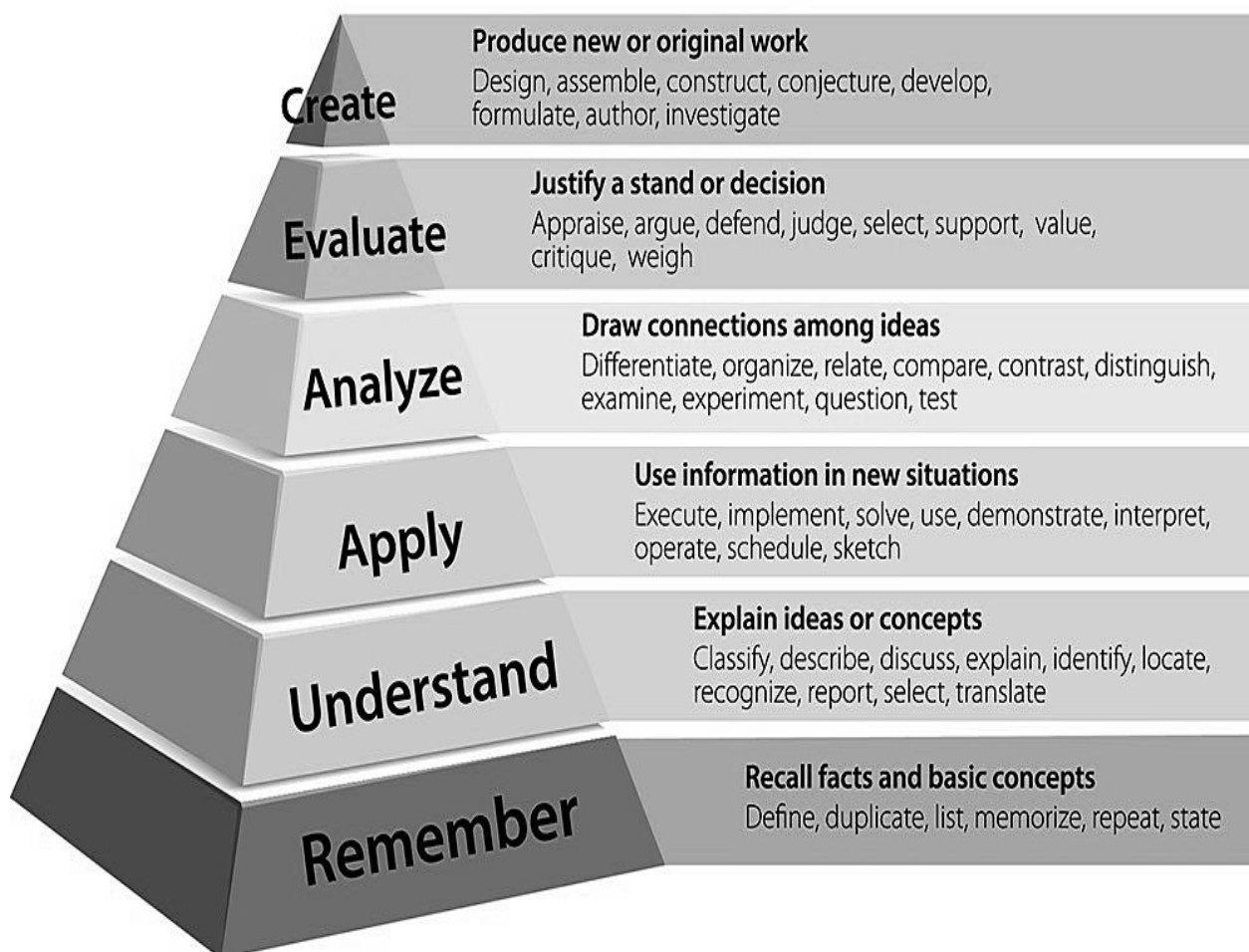


Fig 1.4: Bloom's Taxonomy

A suggestive list of skills/ competencies to be demonstrated at each of the Bloom's level and corresponding cues/ verbs for the examination/ test questions are given in Table 1.2 below:-

Table 1.2: Bloom's Taxonomy – Skills and Verbs

S.No	Level	Skill Demonstrated	Question/Verbs for tests
1	Remember	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
3	Apply	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Break down a complex problem into parts • Identify the relationship 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
5	Evaluate	<ul style="list-style-type: none"> • Compare and discriminate between ideas • Assess value of theories, presentations make • Choices based on reasoned argument verify value evidence recognize subjectivity use of definite criteria for judgements 	Assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6	Create	<ul style="list-style-type: none"> • 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

It may be noted that some of the verbs in the above table are associated with multiple Bloom's Taxonomy level. These verbs are actions that could apply to different activities.

1.3 OBE AWARENESS TO LEARNERS & INSTRUCTORS AS A PART OF TEACHING LEARNING PROCESS

Outcome Based Education process information is to be widely circulated to the students through:

- Uploading in institute website where learners and instructors can access
- Faculty induction programmes for OBE are to be arranged for all the faculty by an OBE expert during semester break period.
- The salient features of the Outcome Based Education are to be explained to the students at the start of every semester by the respective course instructors.

1.4. VISION –MISSION

Vision: A vision statement is a document that states the current and future objectives of a College/Department. The vision statement is intended as a guide to help the college / department make decisions that align with its philosophy and declared set of goals.

Mission: The mission statement(s) 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.

1.5. PROGRAM OUTCOMES (POs)

Program Outcomes (PO) are to be in line with the graduate attributes as specified in the Washington Accord. POs are to be specific, measurable and achievable. NBA has defined 12 POs and it is common for all the institutions in India. In the syllabus book given to students, there should be clear mention of course outcomes along with CO-PO course articulation matrix for all the courses.

1.6. PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline. Usually there are 2-4 PSOs for a program.

1.7. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

- PEOs of the program seeking accreditation may form 3 to 5 PEOs.
- The PEOs should be consistent with the mission of the institution.
- All the stakeholders should participate in the process of framing PEOs.
- Different surveys are to be conducted from stakeholders and to be analysed for the formation of PEOs at department level.

- The number of PEO's should be manageable.
- The programme shall demonstrate how the PEOs are aligned with the mission of the department/ institution
- The PEOs are reviewed periodically based on feedback of the programme's various stakeholders
- The department PEOs will be formed by Department BoS & ratified draft will be forwarded to Academic Council and Governing Body for final approval.

1.8. ROLE OF OBE PROCESS IN CURRICULUM DEVELOPMENT AND IMPLEMENTATION

Outcome based education concepts are mainly helpful in designing the curriculum for the B.Tech Programme in an effective way. Various phases of OBE process in designing the curriculum are shown in Fig.1.5

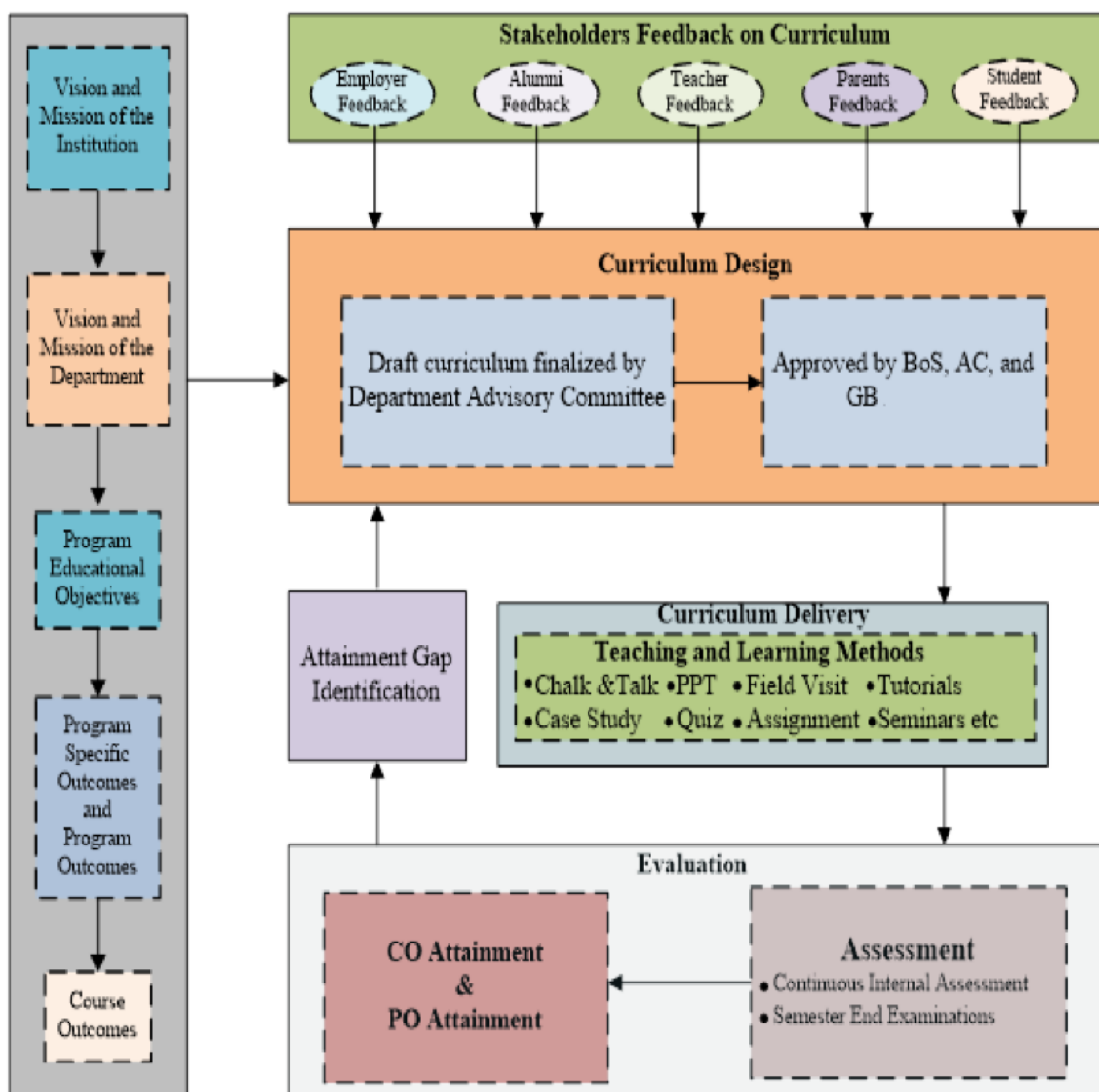


Fig. 1.5: Role of OBE process in the Evolution of Program Curriculum

1.9. COURSE OUTCOMES (COs) ATTAINMENT

Course outcomes attainment is to be calculated after teaching learning process is completed through various pedagogical elements i.e., Classwork, Seminar, Workshops etc. CO attainment is to be calculated based on the evaluation results obtained from different assessment criteria i.e., Sessional Examinations, Semester End Examinations, Assignments, Quiz etc. by the faculty members.

Attainment of course outcome will be the ratio of actual result obtained to the expected result based on the targets set for that course. Complete process of co attainment will be discussed in the next section.

1.10. PROGRAM OUTCOME (PO) & PROGRAM SPECIFIC OUTCOME (PSO) ATTAINMENT

Program Outcomes (PO) and Program Specific Outcomes (PSOs) attainment is dependent on the attainment of Course outcomes only. Initially, we need to ascertain the correlation of a course outcome with each PO/PSO at different levels, which is denoted as CO-PO-PSO mapping. After CO-PO-PSO mapping is completed, CO attainment will be the input for PO/PSO attainment calculation, which will be discussed in detail in the next section.

CO-PO-PSO ATTAINMENT MAPPING

- The process of attainment of COs, POs starts from writing appropriate COs for each course of the program.
- Then, a correlation is established between Cos and POs in the scale of 1 to 3, 1 being the slight (low), 2 being moderate (medium) and 3 being substantial (high).
- A mapping matrix is prepared in this regard for every course in the program including the elective subjects.

Example:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	1	2
CO2	2	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	1	1	-	-	1	-	2	-	-	-	-	2	-
CO4	-	1	1	1	-	-	-	-	-	-	1	-	1	-
CO5	1	1	-	-	1	-	-	1	-	-	-	-	1	3

1.11. BRIDGING THE CO ATTAINMENT GAP

In the outcome based education, it is mandatory to upgrade or modify the Teaching-Learning Process (TLP) from time to time according to the course outcome attainment. Starting from definition of course outcome to attainment of course outcome, teaching learning process includes many stages. Initially Course instructor will set a target or threshold percentage i.e., 1.8 in present case.

After the CO attainment is calculated, the activities to be completed are

- Gap analysis
- Action plan

Both of the above need to be made ready in order to bridge the attainment gap.

1.12. BRIDGING THE PO/PSO ATTAINMENT GAP

Similar to the academic learning gap in case of course outcome, program outcome gap will be also be calculated based on the fact that Graduate Attributes Gaps need to be identified and remedial action need to be initialized.

As Program outcome attainment also has Direct and Indirect Components, Final PO/PSO attainment will be calculated as a Weighted Average. The weightages for Direct PO/PSO and Indirect PO/PSO components will be 90% and 10% respectively.



CHAPTER 2

PROCESSES FOR OBE COMPONENTS

2.1. FRAMING VISION, MISSION, PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The various processes to formulate Vision and Mission of the Institute and Department, Program Educational Objectives, Program Outcomes and Program Specific Outcomes will be explained as under.

PROCESS OF FRAMING VISION AND MISSION

- Collect the basic inputs i.e., Vision and Mission of Affiliating University and other premiere institutes.
- Involve all stakeholders to get inputs.
- Gap analysis or SWOC analysis
- Graduate Attributes
- Discussion, Brain storming by College Academic Committee(CAC) to prepare Draft copy
- After thorough review and analysis by faculty members and staff, if no modifications are necessary it will be forwarded to Academic Council and Governing body for final approval
- After discussion, if no modifications are necessary, Academic Council and Governing Body will ratify the Vision and Mission of the institute
- College will disseminate Vision and Mission statements to all the stakeholders.

The entire process of framing Vision and Mission is shown in Fig. 2.1.

PROCESS FOR FRAMING VISION, MISSION, PEO'S, PO'S AND PSO'S OF THE DEPARTMENT

Vision, Mission, Program Educational Objectives, Program Outcomes and Program Specific Outcomes of the department are to be framed by taking various inputs i.e. Vision and Mission of the Institute, Department SWOC Analysis, Graduate Attributes and opinions of the stakeholders (internal and external) and executing various phases as under.

1. Collect the various inputs for Brainstorming sessions by the departments' faculty members.
2. After Brainstorming sessions, department faculty will prepare Draft copy of Vision, Mission, PEOs, POs and PSOs.
3. The draft copy is to be verified and modified by Program Assessment Committee (PAC) and Department Advisory Committee (DAC).
4. The modified draft copy after checking whether it is in-line with Institute's Vision and Mission will be sent to Board of Studies for Approval.
5. After ratification by BoS, it is to be approved by Academic Council and Governing Body.
6. After the final ratification by the Academic Council and Governing body, college will disseminate Vision, Mission, PEO's, POs and PSO's of the department to all the stakeholder.

All the above steps are clearly shown in Fig. 2.2.

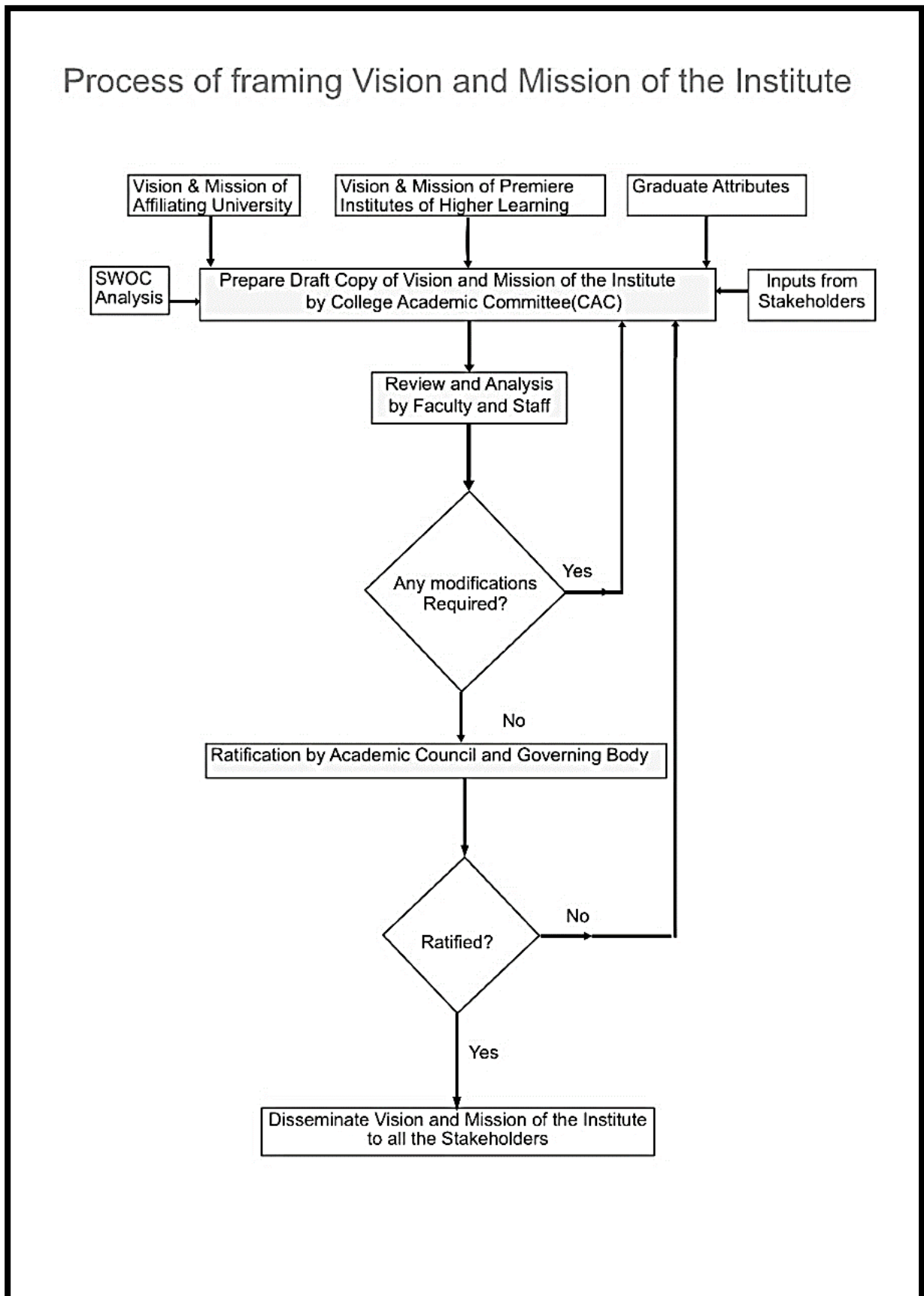


Fig.2.1: Process of framing Vision and Mission of the Institute

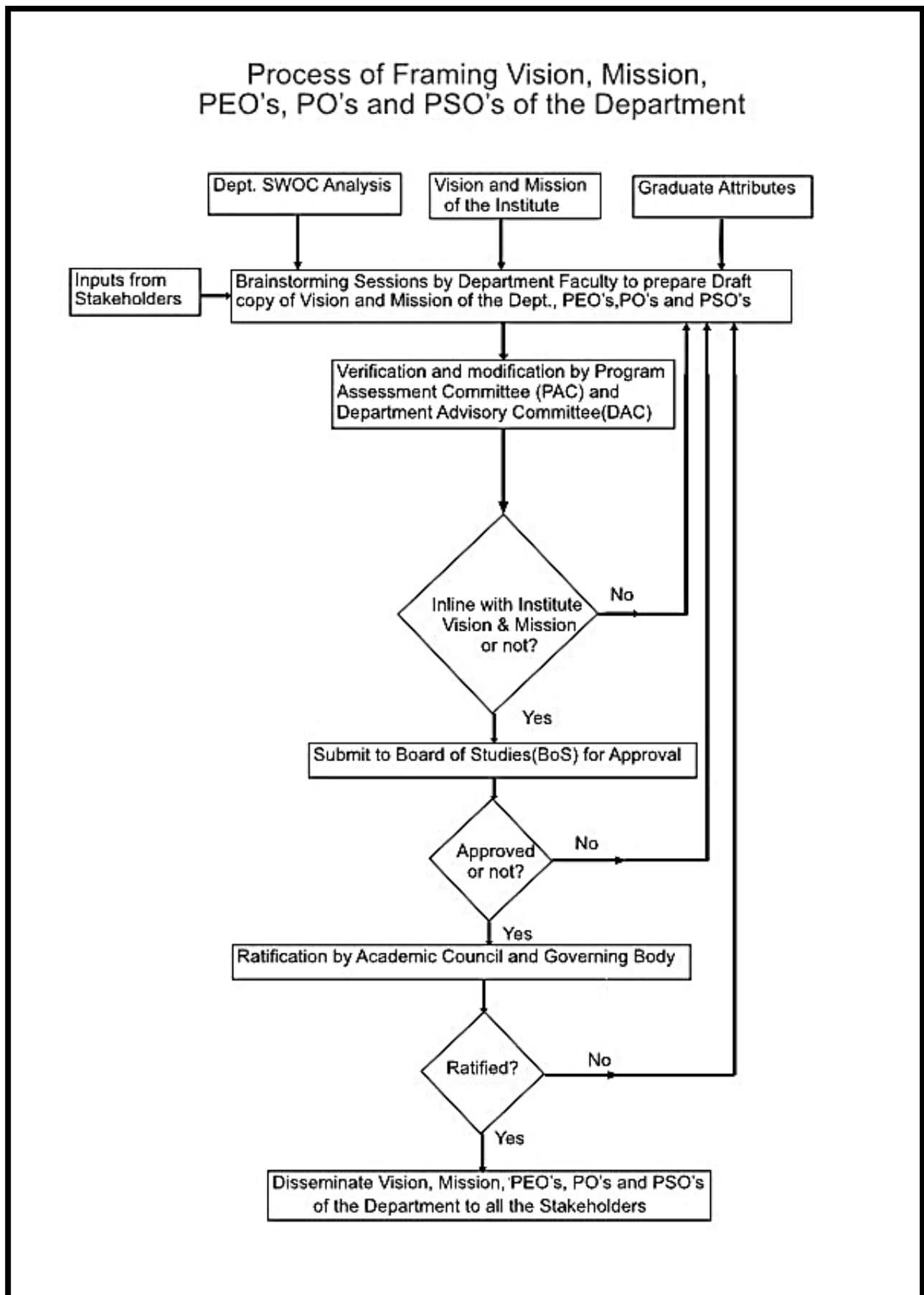


Fig. 2.2 : Process of framing Vision, Mission, PEO's, PO's and PSO's of the Department

2.2. GUIDELINES FOR WRITING COURSE OUTCOMES

Course Outcomes (COs) will be formed for each subject in all the programs. All the instructors dealing a particular subject will formulate the course outcomes.

- COs will be formed by the instructors dealing the same subject and authority for approving COs will be department BoS in consultation with HoD.
- 5-6 COs can be framed per subject, and COs are formed by considering the learning levels of Bloom's Taxonomy.

Structure of Course Outcomes:

Course Outcome statement may be broken down into two main components:

- **An action word** that identifies the performance to be demonstrated;
- **Learning statement** that specifies what type of learning will be demonstrated in the performance;

Examples of good action words to include in course outcome statements:

- Compile, identify, create, plan, revise, analyze, design, select, utilize, apply, demonstrate, prepare, use, compute, discuss, predict, assess, compare, rate, critique, outline, or evaluate

Examples:

A well-written course outcome will be as explained under.

At the end of the course, student is able to:

1. **Apply** laws of physics (eg..Hooke's law, etc..) to compute different types of response (stress and deformation) in the given materials. (PO 1)
2. **Analyze** structural elements for different force systems to compute design parameters (BM and SF) (PO2)
3. **Design** compression elements using engineering principles to resist any given loads. (PO3)
4. **Conduct** experiments to validate physical behavior of materials/ components.(PO4)
5. **Prepare** laboratory reports on interpretation of experimental results (P10)

2.3. PROCESS OF CURRICULUM DESIGN

To realize the Vision and Mission statements of an institution, it is necessary to design the curriculum to be inline. After finalizing the Vision and Mission of the Institute and the department, Program Educational Objectives, Program Outcomes and Program Specific Outcomes, it is necessary to frame Course Outcomes (CO) which are the root level learning objectives in the Outcome Based Education. The process of Course outcomes preparation and mapping with Program Outcomes and Program Specific Outcomes is as follows.

1. By taking the inputs from Vision and Mission of the Institute and Department, PEOs, POs, PSOs, Feedback on the curriculum by stakeholders, brainstorming sessions will be organized to prepare draft copy of course outcomes.
2. After preparing the Course outcomes, mapping with POs and PSOs is done.
3. After mapping process is completed, it is necessary to design the Course content i.e., syllabus which suits to attain the desired Course Outcomes.
4. The draft copy of the Course outcomes and mapping is verified and modified by Department Advisory Committee (DAC).

5. After the approval from DAC, it is submitted to Board of Studies (BoS) for approval or ratification.
6. After being approved from Board of Studies, it is to be ratified by Academic Council and Governing Body.
7. After ratification from Academic Council and Governing Body, college will disseminate Course outcomes and its mapping with Program Outcomes and Program Specific Outcomes to all the stakeholders.

The entire Curriculum Design Process is shown in the Fig. 2.3.

2.4. PROCESS OF CO-PO-PSO ATTAINMENT CALCULATION

- The process of attainment of Cos, POs starts from writing appropriate Cos for each course of the program.
- Then, a correlation is established between Cos and POs in the scale of 1 to 3, 1 being the slight (low), 2 being moderate (medium) and 3 being substantial (high).
- A mapping matrix is prepared in this regard for every course in the program including the elective subjects.
- The course outcomes written and their mapping with POs are reviewed frequently by a BoS before they are finalized.

2.4.1 COURSE OUTCOME ATTAINMENT:

CO Attainment is calculated under two components.

- **Direct assessment**

Direct Assessment refers to the assessment of the activities which are directly connected with an Examination or Test or Quiz where an Instructor will assess the level of attainment of the concepts by all the students of a particular section, by conducting an Examination.

- **Indirect Assessment.**

Indirect Assessment refers to the assessment of level of agreement of the learner about the skills he derived from the Teaching-Learning process. Learner opinions will be collected through various surveys.

Process of Curriculum Design

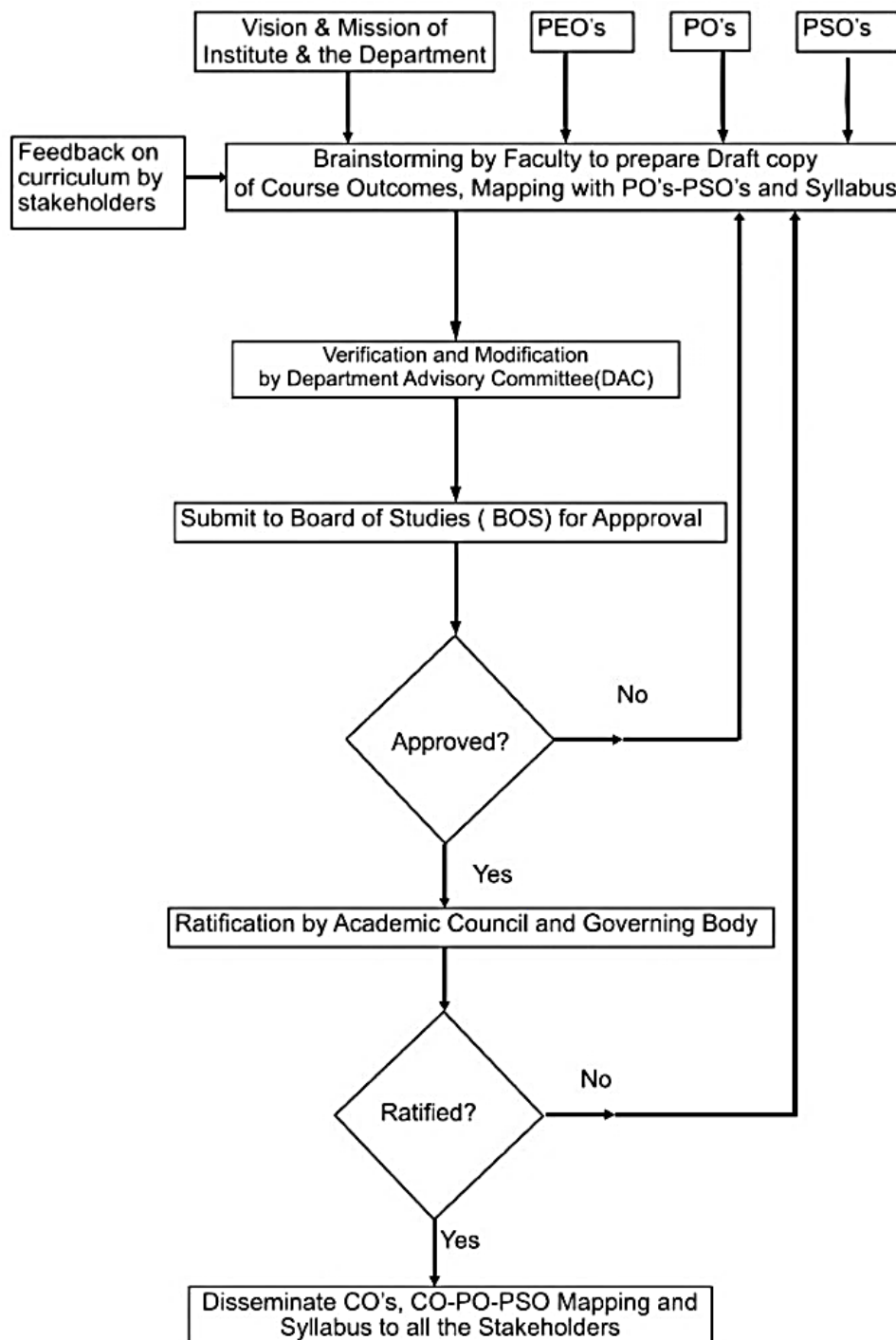


Fig. 2.3: Process of Curriculum Design

2.4.1 a) CO-DIRECT ASSESSMENT

In general, Direct Assessment will have two components

1. Continuous Evaluation Component
2. Semester End Examination Component

In Continuous Evaluation component, instructor will have direct interaction with all the students during the Semester period. During the course time, Instructor will conduct Sessional Examination or Assignment or Quiz or Slip Test or Flash Test etc. to assess the students' attainment in getting the concepts defined in Course outcomes. After the course instruction period is completed, Semester End Examination will be conducted.

The composition of Continuous Evaluation and Semester End Examination for a Theory course is proposed as follows.

Continuous Evaluation	Semester End Examination	Total
40	60	100

- In Aditya Engineering College (A), the proposed Sub-Components of Continuous Evaluation Process are :
 - Sessional -1 Examination – Descriptive Test
 - Sessional -1 Examination – Objective Test
 - Sessional -1 Examination - Assignment
 - Sessional -2 Examination – Descriptive Test
 - Sessional -2 Examination – Objective Test
 - Sessional -2 Examination - Assignment
 - Sessional Examination 1 and 2 will be conducted according to the dates mentioned in the Academic Calendar.
- The composition and award of marks or grades in various assessment tools i.e., Descriptive test, Objective test and Assignment test will be as per the resolutions of the Academic Council. It is recommended by the Academic Council that the division of marks for Sessionals and Externals has to be 40% + 60%.
- The marks composition of Descriptive Test, Objective Test and Assignment in different academic regulations is as follows:

Descriptive	Objective	Assignment	Total
24	10	6	40

- The test composition of Descriptive Test, Objective Test and Assignment in different academic regulations is proposed as follows:

Descriptive	Objective	Assignment	Total
3 Questions of 8 marks each	20 questions of ½ mark each	3 questions of 2 marks each	40

- The time duration for Descriptive Test and Objective Test is 90 minutes and 20 minutes respectively.
- In the Descriptive Test and Objective Test, each question is appended with its concerned Course Outcome as shown in the specimen below.

Q.No	Question	CO
1a	<Question 1a>	CO1
1b	<Question 1b>	CO2

PROCESS TO SET TARGET PERCENTAGE ATTAINMENT FOR COURSE OUTCOMES

In Outcome based education (OBE) process, it is essential to set a primary target to be set by the Course Instructor prior to the starting of the academic sessions i.e., before the Semester instruction begins. The target setting process necessitates discussion among Course Instructors, Course Coordinator and HOD of the Department.

After discussion, committee will decide the primary targets for each Course Outcome of all the Courses in that Semester. Various factors to be considered in setting the targets are :

- Complexity of the Concepts included in that Course Outcome(CO)
- Number of hours to be engaged for that CO
- Feedback Report or Opinion from instructors who dealt that Course earlier.
- Performance levels of the Learners based on Academic record(s).
- Feasibility of the particular Course to have Demonstration or Equipment Exposure inside a Laboratory

PRIMARY TARGETS FOR COURSE OUTCOMES

After the OBE process to set the targets for the Course Outcomes, it is decided to set 60% (i.e. 1.8 out of 3) as primary target for each Course Outcome. The motto behind this fixation of 1.8 out of 3 is that if we set a target at low level i.e., 1.0, attainment gaps in Teaching-Learning Process(TLP) may not be identified as we will get the Attainment in most of the cases i.e., Courses. So, to extract the inherent difficulties in TLP, it is suggested to set a target of 60% (1.8 out of 3) for each Course.

Levels associated with CO Attainment

For any Course Outcome, if 60% of the students got more than Threshold percentage (1.8 or 60%) the associated level will be 1. If 70% of the students got more than Threshold percentage (1.8 or 60%) the associated level will be 2. If 80% of the students got more than Threshold percentage (1.8 or 60%) the associated level will be 3.

First level	1	means 60% students attained more than target %
Second level	2	means 70% students attained more than target %
Third level	3	means 80% students attained more than target %

CALCULATION OF CO ATTAINMENT IN SESSIONAL EXAMINATION

After the Sessional Examination scripts of all the students are validated by the Course Instructor(s), Marks data will be stored in an Excel file enabling data retrieval to be easy enough.

In every sessional examination, there will be 3 components as mentioned earlier, namely Descriptive, Objective and Assignment. In the sessional paper, three (3) questions will be given for Descriptive Examination. Course Outcome (CO) for each question or section of a question i.e., a or b etc., will be indicated.

CO ATTAINMENT CALCULATION FOR SEMESTER END EXAMINATION

After the Sessional Examination attainment calculation, we need to calculate the attainment for Course Outcomes from the Semester End Examination. It is necessary to collect the question wise data for each student from the Examination Cell. The targets for the Course outcomes are same as of sessional examinations.

In the Semester End Examination, as the learner will have choice of answering the questions, internal choice will be given. Question paper consists of 10 questions having internal choice i.e., learner can answer 1 or 2, 3 or 4, 5 or 6, 7 or 8 and 9 or 10. Proper care should be taken by the Paper setter to have equal contribution to all the Course outcomes in the Question paper.

Course Outcome attainment calculation for the Semester End Examination will also be in the similar lines of Sessional Examination Attainment calculation. The only difference is that there will be not be any choice in the sessional examination, whereas in Semester End Examination, it will be. If any Course outcome appears many times in the Question paper the final attainment value of that Course outcome will be the average of all the individual components.

2.4.1 b) CO- INDIRECT ASSESSMENT

Indirect assessment for a Course will be done by means of Course Exit Survey. At the end of the Semester, every student has to fill a form in which he /she has to mention the level of their ability to perform the activity defined in a Course Outcome.

The level varies from 1 to 5 based on his/her agreement of student in getting the skills mentioned in Course Outcome definition. Students' agreement level for any course outcome will be as follows.

Level	Description	Numerical value assigned
1	Strongly Agree	5
2	Agree	4
3	Neutral	3
4	Disagree	2
5	Strongly Disagree	1

2.4.2 CALCULATION OF COURSE OUTCOME ATTAINMENT

Course outcome attainment calculation from Sessional Examinations, Semester End Examination and Indirect Survey is consolidated as weighted average of the individual components' contribution.

The Sessional Examinations contribute to 40% of Direct Assessment and Semester End Examination contributes to remaining 60% of Direct Assessment.

The Total Course Outcome Attainment comprises of Direct CO Attainment which is obtained through Assessment i.e., Examinations and Indirect CO Attainment which is obtained through Course Exit Survey. The composition of Direct CO Attainment and Indirect CO Attainment will be 90% and 10% respectively.

CO-Direct Attainment

= (40%) CO-Sessional Attainment + (60%) CO-Semester End Examination Attainment

CO- Indirect Attainment will be directly obtained from the Course Exit Survey on a scale of '3'.

Consolidated CO Attainment

= 90% of CO-Direct Attainment + 10% of CO-Indirect Attainment

2.5 PROCESS FOR PROGRAM OUTCOME (PO) & PROGRAM SPECIFIC OUTCOME (PSO) ATTAINMENT

The attainment of Program Outcome as well as Program Specific Outcome will be based on the relative mapping of Course Outcomes with PO and PSO. For this, primarily, CO_PO_PSO mapping has to be done properly.

Every Course Outcome by virtue of its content will induce some qualities or skills in the learners. Course instructor must disclose the skills to be induced by a particular Course Outcome in relation to PO1 to PO12.

There will be some correlation or synchronization of the skills expected from Graduate Engineer (PO) and skills induced through Instruction process (CO). We must assign some numerical values to have a measurement for comparison. It is suggested by OBE community that levels 1,2 and 3 can be assigned based on CO_PO_PSO mapping. If the synchronization is substantial or high, CO-PO mapping level is '3'.

Example:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	1	2
CO2	2	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	1	1	-	-	1	-	2	-	-	-	-	2	-
CO4	-	1	1	1	-	-	-	-	-	-	1	-	1	-
CO5	1	1	-	-	1	-	-	1	-	-	-	-	1	3

MAPPING STRENGTH:

It is the numerical measure of the extent of correlation of a particular Program outcome with the Course as a total.

It is calculated as an average of mapping values of a particular Program outcome with all the Course outcomes of a course

For example, the Mapping Strength of PO1 taking CO-PO-PSO mapping table above will be calculated as.

$$\text{Mapping strength of PO1} = \text{Average of } \{3, 2, 2, 1\} = (3+2+2+1)/4 = 2$$

Similarly mapping strengths of PO2 to PO12 and PSOs also can be calculated.

CALCULATION OF PO & PSO ATTAINMENT

Program Outcome Attainment and Program Specific Outcome Attainment of a Course is having two components namely, Direct Attainment and Indirect Attainment in the similar lines of Course Outcome Attainment.

- Direct Attainment refers to the attainment of PO/PSO through CO Attainment
- Indirect Attainment refers to the attainment of PO/PSO through Surveys i.e., Program Exit Survey, Alumni Survey, Parents Survey and Employer Survey.

CALCULATION OF PO-DIRECT ATTAINMENT

Direct Program Outcome Attainment and Program Specific Outcome Attainment will be calculated directly from the Course Outcome Attainment through a formula taking inputs from CO-PO-PSO mapping table.

$$\begin{aligned} &\text{PO/PSO Attainment} \\ &= (\text{Mapping Strength} / 3) * \text{Average Attainment of Mapped Course Outcomes} \end{aligned}$$

Example:

In the earlier section, for PO1, Mapping strength = 2.00. Here PO1 is mapped with CO1, CO2, CO3 and CO5 at 3, 2, 2 and 1 levels respectively.

Let the CO attainments of CO1, CO2, CO3 and CO5 be 2.12, 2.34, 1.56 and 2.56 respectively. Now the PO1 Direct Attainment

$$= (\text{Mapping Strength} / 3) * \text{Average Attainment of Mapped Course Outcomes}$$

$$= (2.00/3) * \text{Average of } (2.12, 2.34, 1.56, 2.56) = (2/3)*2.145 = 1.43$$

It is declared that PO1-Direct Attainment for a Course 1 is 1.43

Similarly, attainments for other POs are also calculated.

CALCULATION OF CONSOLIDATED PO/PSO DIRECT ATTAINMENT

The consolidated PO-Direct Attainment of all the program outcomes is calculated as an Average of (PO-Direct Attainments) of all the Courses which are mapped with those Program Outcomes.

To sum up easily, all the values are to be entered in a matrix. The final value of a Program Outcome for a list of courses will be the Arithmetic Average of all the Direct PO Attainments of the Individual Courses listed together.

Example:

Let PO1, Direct Attainment values for the Courses C201, C202, C304 and C403 are 1.43, 2.41, 1.22 and 2.67 respectively. Then Consolidated Direct PO Attainment for PO1 will be Arithmetic Average of (1.43, 2.41, 1.22 and 2.67) = **1.933**

CALCULATION OF PO-INDIRECT ATTAINMENT

Indirect PO attainment calculation will be done through Survey Reports. They are

- Program Exit Survey
- Alumni Survey
- Employer Survey
- Parents' Survey

All the survey reports will calculate the PO attainment in '3' scale. The process is similar to the Indirect Survey attainment calculation in the case of Course Outcome Indirect Survey. Consolidated Indirect PO Attainment will be the Arithmetic Average of all the survey reports mentioned above.

PO1 attained Consolidated Indirect PO Attainment as **2.38** for the scale of '3'. But, the indirect survey calculations are to be equalized with reference to Mapping Strength of PO1 in the CO-PO-PSO Table by multiplying with (1/3) * **Mapping Strength**.

CALCULATION OF FINAL PO ATTAINMENT

Final Consolidated Program Outcome Attainment will be Weighted Sum of Consolidated Direct Attainment and Consolidated Indirect Attainment of individual Program Outcome. The weightages for Direct and Indirect components are 90% and 10% respectively.

FINAL PO ATTAINMENT

= 90 % of Direct PO Attainment + 10% Indirect PO Attainment

In the example discussed above, for PO1, Direct Attainment is **1.933** and Indirect Attainment is **0.793**.

Now, FINAL PO ATTAINMENT = $0.9 * 1.933 + 0.1 * 0.793 = \mathbf{1.819}$

In the same way, Final PO Attainment values will be calculated for all other Program Outcomes.

2.6 BRIDGING THE CO ATTAINMENT GAP

In the Outcome Based Education, it is mandatory to upgrade or modify the Teaching-Learning Process (TLP) from time to time according to the Course Outcome Attainment. Starting from

Definition of Course outcome to Attainment of Course outcome, Teaching Learning process includes many stages. Initially Course instructor will set a target or threshold percentage i.e., 1.8 in present case.

- After the valuation process is completed, a consolidated statement is prepared comparing the Threshold CO attainment and Actual CO Attainment. The difference between Threshold CO attainment and Actual CO Attainment will be called as 'Attainment Gap'.
- If the 'Attainment Gap' is positive, it indicates that the Teaching Learning Process (TLP) being followed for that Course is resulting well in improving the skills of the learners as desired in the definition of Course outcome. In this case, target value or threshold value of CO attainment can be improved.
- For the analysis purpose, it is recommended to continue the same target to compare two academic batch students.
- If the 'Attainment Gap' is negative, it indicates that the Teaching Learning Process (TLP) needs some corrections or modifications which will be suggested primarily by the Course Instructor who dealt that Course recently.
- As a part of improvement in TLP, Course Instructor being fully aware of the Present Instruction process, Paper setting process and Paper valuation process, has to recommend or suggest the Action proposed to bridge the gap. After the results are announced, Course instructors have to get the data and analyse it for Course Outcome Gaps. Instructor has to find the gaps in the Teaching learning process of his course. The gaps in the TLP are to be filled by taking remedial action for the next batch of students for the same course. The '**action proposed to bridge the gap**' needs to be dynamic in filling the earlier CO Gaps.
- The suggestions of the present Course Instructor to bridge the gap between Threshold CO Attainment and Actual CO Attainment are to be carried to the Course Instructor(s) who are going to deal with that Course in the next semester(s) by the Department OBE coordinator or HOD of the Department.
- Based on the earlier suggestions to improve the TLP, next level Course Instructors will decide the modifications in their TLP so that CO attainment gap can be reduced or made positive.

2.7 BRIDGING THE PO/PSO ATTAINMENT GAP

Similar to the Attainment Gap in the case of Course Outcome, Program Outcome Gap will also be calculated and remedial action needs to be initialized. Final PO /PSO Outcome Attainment is to be compared with the Mapping Strength of the CO-PO-PSO to find the PROGRAM OUTCOME GAP. Program Outcome Gap enables us to find solutions to fill the gap through academic activities.

In the earlier section discussed, for PO1, Final Attainment value is 1.819 whereas Mapping strength is 2.00.

Now the PO gap for PO1 will be $2.00 - 1.819 = 0.181$

Similarly, PO attainment gaps will be calculated for all the other program outcomes.



CHAPTER 3

EXAMPLES

After implementing all the processes discussed in the earlier chapters, the output of the processes will be evolved as follows.

3.1. VISION –MISSION OF THE INSTITUTE AND DEPARTMENTS

The vision and mission of the College and various departments are presented as below.

VISION AND MISSION OF THE INSTITUTE

VISION

To induce higher planes of learning by imparting technical education with international standards, applied research, Creative ability and Value based instruction to emerge as a premier institute.

MISSION

Achieving academic excellence by providing globally acceptable technical education by forecasting technology through

- Innovative research & development
- Industry institute interaction
- Empowered manpower

DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a recognized leader in civil engineering with values and innovation.

MISSION

M1: Practice quality learner centric teaching learning process abreast with changing industry needs and societal challenges

M2: Provide Quality infrastructure that encourages innovation.

M3: Establishing successful industry and institutional collaboration.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To excel in electrical education, research and technological services in tune with societal needs.

MISSION

- M1: Impart quality education and services towards skills.
- M2: Develop cutting edge at research and sustainable technologies, by collaborating with industries.
- M3: Nurture scientific temperament, Professional ethics among the stakeholders.

DEPARTMENT OF MECHANICAL ENGINEERING**VISION**

To be a nationally preferred knowledge hub in Mechanical Engineering Department with commitment towards critical thinking, quality research and innovation.

MISSION

- M1: Inculcating strong mathematical and computing fundamentals that form the baseline for modern day solutions with emphasis on design and development.
- M2: Impart leadership and interpersonal skills for the stake holders.
- M3: Collaborate with industry, academia and R&D organizations for excellence in teaching, research and consultancy services.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**VISION**

To become a centre of excellence in Electronics and Communication Engineering with technological capability, professional commitment and social responsibility.

MISSION

- M1: Provide quality education through well-equipped laboratory facilities in collaboration with the industries and effective teaching-learning process.
- M2: Promote cutting edge technologies in order to serve the needs of the society, industry, government and scientific community through research.
- M3: Equip the students with strong foundations in personality development and communication skills towards employability.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**VISION**

To become a competent centre of excellence in Computer Science and Engineering to meet the needs.

MISSION

- M1: Impart quality and value based education.
- M2: Inculcate the interpersonal skills and professional ethics.
- M3: Enable research through state-of-the-art infrastructure.
- M4: Collaborate with industries and communities.

DEPARTMENT OF INFORMATION TECHNOLOGY**VISION**

To emerge as a premier department with quality of education, technical competency and innovations.

MISSION

- M1: Provide an academic environment with quality infrastructure for solving real world problems and work in multi-disciplinary teams.
- M2: Impart value based education in innovative research and leadership aspects.
- M3: Collaborate with the industry and academia towards addressing the evolving changes in Information Technology and related areas.

DEPARTMENT OF PETROLEUM TECHNOLOGY**VISION**

To attain recognition in research and equip students for meeting the challenging needs of petroleum, allied industries and society.

MISSION

- M1: To provide excellent instruction and design experience essential for Petroleum Engineers.
- M2: To develop research that communicates, and applies new knowledge for the betterment of society.
- M3: To assist the public in addressing issues concerning the use of resources, protection of the environment, through service and leadership.

DEPARTMENT OF MINING ENGINEERING**VISION**

To prepare the graduates in the major fields of mining engineering at par with international standards.

MISSION

- M1: By upgrading mining engineering education through training of faculties regularly.
- M2: By providing state of the art laboratory facilities & constantly updating it.
- M3: By exposing the real time technologies practiced in mining industries.

DEPARTMENT OF AGRICULTURAL ENGINEERING**VISION**

To make the Agricultural Engineering education known for its contribution to agriculture and allied fields in making agriculture more sustainable and profitable.

MISSION

- M1: Implementation of new technologies for the farmers on sustainable food production through precision agriculture and mechanized food processing.
- M2: Educating the students to integrate knowledge of agricultural engineering fundamentals and design of systems involved in food production, processing, storage, handling, distribution and use of food.
- M3: Developing the good atmosphere/foundation between the students and faculty to perform and lead engineering projects and make significant contributions for the benefit farming community.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**VISION**

To achieve excellence in the field of AIML and nurture the professionals, to build sustainable and intellectual solutions with natural intelligence that meets the beneficiary of industry and society.

MISSION

- M1: Impact the knowledge through states-of-the-art concepts, tools and techniques in Artificial Intelligence and Machine Learning.
- M2: To promote technical competence in AIML graduates that satisfies the needs of the Industry and societal challenges.
- M3: Inculcate ethical and environmental consciousness, leadership qualities and life-long learning that ensures the holistic development of students.
- M4: Establish centers of excellence in leading areas of computing with Artificial Intelligence and Machine Learning

3.2. PROGRAM OUTCOMES (PO's)

The twelve Program Outcomes are described as below.

After successful completion of the program, the graduates will be able to

- PO 1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO 2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- PO 3 **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
- PO 4 **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
- PO 5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- 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
- PO 7 **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
- PO 8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- PO 9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- PO 10 **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.
- PO 11 **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.
- PO 12 **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.

3.3. PROGRAM SPECIFIC OUTCOMES (PSO's)

The Program Specific Outcomes of all the departments are presented as below.

Department of Civil Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Survey, map, measure and analyse data for sustainable smart city infrastructure
- PSO 2 Design Water supply and waste water treatment systems for Public Health and safety

Department of Electrical Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Apply computational techniques to design and analyze renewable energy systems.
Analyze the advanced topics in electrical engineering for the innovation and
- PSO 2 development of sustainable society.

Department of Mechanical Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Apply design techniques to arrive at an optimal solutions in design, analysis, fabrication of professional automobile competitions.
- PSO 2 Demonstrate essential skills to analyze the thermal, fluid systems and processes.

Department of Electronics and Communication Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Apply the knowledge of Electronics and Communications in analysing problems related to Electronics, Communications, Signal processing, VLSI and Embedded systems.
- PSO 2 Use modern tools and techniques to solve contemporary problems in the field of Electronics and Communication Engineering.

Department of Computer Science and Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Develop efficient computerized solutions to real world problems through the application of principles in Data structures, Analysis of algorithms, Computer Networks, DBMS, Software Engineering and Object Oriented Analysis and Design.
Apply the knowledge in Data mining, Cloud Computing, Artificial Intelligence,
- PSO 2 Machine Learning and Big Data Analytics to infer, predict or prescribe data centric business solutions.

Department of Information Technology

After successful completion of the program, the graduates will be able to

- PSO 1 Develop IT solutions to specific business problems using current programming languages and software tools.
- PSO 2 Use acquired foundational skills and knowledge to learn future technologies and employ them research applications of government or industrial sectors

Department of Petroleum Technology

After successful completion of the program, the graduates will be able to

- PSO 1 Develop IT solutions to mitigate business challenges using AIML and IOT technologies.
- PSO 2 Use acquired foundational skills and knowledge to learn future technologies and employ them in research applications.

Department of Mining Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Identify, formulate, and solve Mining & Mineral engineering problems.
- PSO 2 Use the techniques, skills, and modern engineering tools, like mine planning and blast optimization software necessary for Mining engineering practice.
- PSO 3 Pursue broad education necessary to understand the impact of Mining engineering solutions in a global and societal context.

Department of Agricultural Engineering

After successful completion of the program, the graduates will be able to

- PSO 1 Develop skills necessary to design the process and evaluate and come out with problem solutions of farm implements through adequate farm power for sustainable agriculture and to gain better employment in various industries of agricultural engineering.
- PSO 2 Develop expertise in planning and management of natural resources through advanced soil and water conservation techniques and various irrigation and drainage methods with the skill of data interpretation.
- PSO 3 Contribute towards enhancing farmer income & play a dynamic role in the circular economy through technology intervention in promoting sustainable food supply chain & processing of agro-food produce.

Department of Artificial Intelligence and Machine Learning

After successful completion of the program, the graduates will be able to

- PSO 1 Apply the core concepts of computational and optimized algorithms to produce efficient and effective solutions.
- PSO 2 Apply the technical and research capability skills in AIML using innovative tools and techniques to provide solutions in the areas of engineering, industry and society to become successful graduate/entrepreneur.

3.4. PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

Department of Civil Engineering

Graduates of the Program will

- PEO 1 Pursue research in the emerging areas
- PEO 2 Analyze, design and build safe, sustainable and economical structures
- PEO 3 Engage in life-long learning to serve for the betterment of the environment

Department of Electrical Engineering

Graduates of the Program will

- PEO 1 Create multidisciplinary projects as an individual or as a team member.
- PEO 2 Design and develop innovative products and services in the field of Electrical and Electronics engineering.
- PEO 3 Engage in lifelong learning, career enhancement and adopt to changing professional and societal needs.

Department of Mechanical Engineering

Graduates of the Program will

- PEO 1 Progress in professional career with a solid foundation in mathematics, science and engineering.
- PEO 2 Use the professional knowledge and enhance multidisciplinary skills to solve the real time engineering challenges for sustainable societal development.
- PEO 3 Demonstrate interpersonal skills in the chosen profession and research.

Department of Electronics and Communication Engineering

Graduates of the Program will

- PEO 1 Adapt the learning culture needed for a successful professional career to pursue research in line with the latest technological developments.
- PEO 2 Design and develop modern electronic and communication Systems for the given requirements by considering technical, environmental and social contexts.
- PEO 3 Communicate effectively, demonstrate leadership qualities and develop knowledge of societal impacts of communication technologies with professional ethics.

Department of Computer Science and Engineering

Graduates of the Program will

- PEO 1 Adopt to new technologies and provide innovative solutions in the field of Computer Science and Engineering.
- PEO 2 Employed in industries/public sector/research organizations or work as an entrepreneur.
- PEO 3 Demonstrate interpersonal and multi disciplinary skills to achieve organization goals and serve society with professional ethics .

Department of Information Technology

Graduates of the Program will

- PEO 1 Develop solutions for real world problems and adapt to the ever evolving challenges in Information Technology (IT) and related interdisciplinary areas.
- PEO 2 Communicate effectively with multi-disciplinary teams to develop quality

computing systems with an orientation towards research and development for lifelong learning.

- PEO 3 Use emerging technologies in ethical & professional manner to fulfil industrial & societal needs.

Department of Petroleum Technology

Graduates of the Program will

- PEO 1 Be successful in diverse career paths of the petroleum and allied industries.
PEO 2 Enhance problem-solving skills that involve designing and interpretation of data
PEO 3 Continue professional development and lifelong learning

Department of Mining Engineering

Graduates of the Program will

- PEO 1 Advance in their careers, adapting to new situations and emerging problems, in a variety of professional roles such as mine planner, designer, production manager, mineral processing engineer, consultant, technical support representative and regulatory specialist.
PEO 2 Pursue advanced degrees in mineral-related fields.
PEO 3 Display professional skills such as effective communication, teamwork, and leadership.
PEO 4 Play critical role as a mining engineer in society with respect to health, safety, and the environment in tangible ways such as achieving professional licensure.

Department of Agricultural Engineering

Graduates of the Program will

- PEO 1 Develop diverse capability to work with tractor industries, seed processing industries, irrigation companies and also to run self-entrepreneurship like dairy farming and custom hiring centers.
PEO 2 Solve real time engineering problems using professional knowledge and skills resulting in significant societal development.
PEO 3 Demonstrate multidisciplinary skills to analyze engineering issues in a broader perspective with ethical responsibility towards sustainable development.

Department of Artificial Intelligence and Machine Learning

- PEO 1 Apply core concepts, software engineering and AIML principles to solve complex computing problems and produce optimized solutions.
PEO 2 Pursue higher education and research activities through innovative ideas and latest technology-driven projects in the domain of AIML.
PEO 3 Work in a collaborative environment and also lead the team by understanding the ethical, societal and financial impact of their work.

3.5. COURSE OUTCOMES (COs)

The following table shows the Course Outcomes for a sample course, **BLOCK-CHAIN TECHNOLOGIES**

Course Outcomes: At the end of the Course, Student will be able to:

- CO1:** Demonstrate the blockchain and crypto currency basics
- CO2:** Compare and contrast permissioned and permissionless blockchains
- CO3:** Explain different types of crypto currency wallets
- CO4:** Explain how to compile and deploy smart contracts using Ethereum
- CO5:** Summarize Hyperledger fabric architecture and different use cases

3.6. CALCULATION OF CO ATTAINMENT FOR A THEORY COURSE

The sample screenshot of a sample input data and calculations for a Descriptive Examination, Objective and Assignment is given below in Fig.3.1, Fig. 3.2, Fig. 3.3 and Fig. 3.4.

ADITYA ENGINEERING COLLEGE(A)					
SESSIONAL -1 DATA					
ACADEMIC YEAR			SEMESTER		
BRANCH	<Branch Name>		REGULATION	<Regulation>	
COURSE NAME	Course 1		COURSE CODE	<Course Code>	
DATE OF THE EXAMINATION			SESSIONAL		
COURSE INSTRUCTOR	<Faculty Name>				
	Q1	Q2	Q3	Assignment-I	Objective-I
	A	A	A		
Max.Marks	8	8	8	6	10
COURSE OUTCOME	CO1	CO2	CO2	ALL	ALL
Student 1	3		4	0	6
Student 2	8	0	6	3	6
Student 3	8	3	8	6	6
Student 4	0		5	0	5
Student 5	4	0	7	3	2
Student 6	6	5	5	3	3
Student 7	0	1	0	6	3
Student 8	6	8	8	6	6
Student 9	1	4	4	6	5
Student 10	2		4	5	6

Fig. 3.1: Sessional-1 Data for a Course

Fig. 3.1: Sessional-1 Data for a Course

Student 10	2		4	5	6
TARGET PERCENTAGE in CO (Instructor fixed)	60.00%	60.00%	60.00%	60.00%	60.00%
MARKS SATISFYING TARGET PERCENTAGE	4.8	4.8	4.8	3.6	6.0
NO. OF STUDENTS >= TARGET PERCENTAGE	4	2	6	5	5
COURSE OUTCOME	CO1	CO2	CO2	ALL	ALL
CO ATTAINMENT %	40%	29%	60%	50%	50%
CO ATTAINMENT LEVEL	0	0	1	0	0
ANALYSIS OF ATTAINMENTS	CO1	CO2	CO2	FINAL ATTAINMENT VALUE (average of all individual CO's and combined Assignment &Objective)	
CO1	0			0.00	
CO2		0	1	0.17	
CO3				0.00	
CO4				0.00	
CO5				0.00	
	LEVELS ALLOCATED BASED ON TARGETS ATTAINED				
	First level	1			
	Second level	2			
	Third level	3			

Fig. 3.2: Sessional-I CO Attainment Calculations

Fig. 3.2: Sessional-I CO Attainment Calculations

The various steps involved in CO Attainment Calculation for one question are as follows.

- Question is given for 8 marks and associated with CO1.
- As the threshold percentage is set as 1.8 i.e., 60%, for this question, the marks satisfying threshold percentage will be 60% of 8 i.e., 4.8 .
- Now, the number of students who got 4.8 or above marks for the Question No. 1 is 4 out of 10, who attempted CO1.
- The CO Attainment for the CO1 through Question No. 1 will be 4/10 i.e., 40%
- From the levels associated with CO attainment as mentioned earlier, 40% attainment for CO1 results the level 0.
- In the same way, all other CO attainment levels are calculated.

- In the case of Objective Test and Assignment, it is followed to link all the Course outcomes in the particular Sessional Examination to have equal linkage with total marks of Objective test and Assignment Test i.e., Objective Test is for 10 marks and Assignment is for 6 marks. The threshold is same for both Objective Test and Assignment i.e., 60%. As the CO1 and CO2 are part of Sessional-1, these two will have equal weightage in the CO Attainment Calculation.
- In the specimen sheet above shown, the number of students who got more than 3.6 marks (60% of 6) for Assignment test is 5 out of 10 which results 50% which is less *than threshold 60%* which results attainment level '0'. This attainment level '0' is attached to both the Course outcomes CO1 and CO2 which are part of Sessional-1.
- Similarly, the CO attainment calculation for Objective test also. The number of students who got more than 6 marks(60% of 10) for Objective Test is 5 out of 10 which results 50% i.e., attainment level '0'.
- If any Course outcome is contributing to more questions or question sections, the final attainment of that CO will be the average of all the attainment values which will be the Net attainment value of that CO from Descriptive Test.
- The FINAL ATTAINMENT VALUE for a Course Outcome is calculated as Average of Descriptive Test, Assignment and Objective Test.

CO attainment values through Sessional-I examinations are shown in Fig. 3.3.

CO Attainment values from Sessional-I Examinations				
ANALYSIS OF ATTAINMENTS	CO1	CO2	CO2	FINAL ATTAINMENT VALUE (average of all individual CO's and combined Assignment & Objective)
CO1	0			0.00
CO2		0	1	0.17
CO3				0.00
CO4				0.00
CO5				0.00

Fig. 3.3: CO Attainment values for Sessional-I

In the same process, CO attainment values in Sessional-II examination also found, shown in Fig. 3.4

CO Attainment values from Sessional –II Examinations							
ANALYSIS OF ATTAINMENTS	CO3	CO3	CO4	CO4	CO5	CO5	FINAL ATTAINMENT VALUE (average of all individual CO's and combined Assignment &Objective)
CO1							0.00
CO2							0.00
CO3	3	3					2.00
CO4			2	0			1.33
CO5					2	0	1.33

Fig. 3.4: CO Attainment values for Sessional-II

The Final attainment calculations of CO1, CO2, CO3, CO4 and CO5 from Sessional examinations are shown in Table 3.1.

Table 3.1: CO ATTAINMENT FROM SESSIONALS

ANALYSIS OF ATTAINMENTS	ATTAINMENT VALUE
CO1	0.00
CO2	0.17
CO3	2.00
CO4	1.33
CO5	1.33

INDIRECT ASSESSMENT OF COURSE OUTCOME

Based on the number of responses for each level, Weighted Average will be calculated for the Scale of 5. Next, this value obtained is converted to '3' scale, as we will have to analyze all the attainments in the scale of 3 only. The specimen for an indirect survey report is shown in Fig. 3.5

ADITYA ENGINEERING COLLEGE(A)								
INDIRECT CO ATTAINMENT(SURVEY)								
ACADEMIC YEAR		SEMESTER						
BRANCH		REGULATION						
COURSE		COURSE CODE						
COURSE INSTRUCTOR								
	COURSE OUTCOMES	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (Neutral) (3)	Disagree (2)	Strongly Disagree (1)	Weighted Average (5)	CO ATTAINED THROUGH SURVEY
CO1	I have the ability to Estimate the heat transfer rate through conduction in various bodies	89	72	7	1	2	4.43	2.66
CO2	I have the ability to Determine the convective heat transfer coefficient in various bodies	70	77	16	6	2	4.21	2.53
CO3	I have the ability to Analyze the heat transfer rate through free convection in various bodies	66	83	14	5	3	4.19	2.52
CO4	I have the ability to Calculate the heat transfer coefficient during boiling and condensation and also the performance of heat exchanger	66	87	11	2	3	4.25	2.55
CO5	I have the ability to Evaluate the shape factor and heat transfer rate through radiation	66	79	18	4	4	4.16	2.50

Fig. 3.5: CO attainment- Indirect

Fig. 3.5: CO attainment- Indirect

Sample Calculation:

- In the Fig. 3, for CO1, Number of responses for different levels Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree are 89, 72, 7, 1 and 2 respectively.
- The Weighted Average will be $[5*89 + 4*72 + 3*7 + 1*2 + 2*1] / [89+72+7+1+2] = 4.43$
- The Weighted Average 4.43, when converted to '3' scale becomes 2.66.
- Similarly, other CO's CO2, CO3, CO4 and CO5 will have Attainments as 2.53, 2.52, 2.55 and 2.50 respectively.

CO ATTAINMENT CALCULATION FOR SEMESTER END EXAMINATION

All the data received from Examination cell will be entered in the Excel form as shown in the Specimen (Fig. 3.6)

- The CO attainment calculation process for a Course Outcome from the Semester End Examination is similar to the calculation process from the Sessional Examination.
- The fixation of Threshold percentage to be attained, calculation of number of students who got more than threshold percentage, calculation of attainment by dividing the earlier number with number of students who attempted that particular Course Outcome etc. will be the same as they are in Sessional Examination Excel Tab.

ADITYA ENGINEERING COLLEGE(A)																				
EXTERNAL EXAM DATA																				
BRANCH										REGULATION										
COURSE NAME										COURSE CODE										
COURSE INSTRUCTOR																				
	Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
	A	B	A	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
Max.Marks	4	8	12	6	6	6	6	6	6	8	4	4	8	6	6	6	6	4	8	
COURSE OUTCOME	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO4	CO4	CO4	CO4	CO5	CO5	CO5	CO5	
Student 1			7	3	3			4	5	5	3	3	4	0		1		3	4	
Student 2			2	3	5	4		0	0	5	3		4	5		4			5	
Student 3	2	6				5	5	5	5	4	3	4	7	1		6	1		6	
Student 4	3	4		6	3	5	5	4	4	5	3	3	3	4		4	4		6	
Student 5			11	4	4	6	5	6	5	5	2		5	6	5		6	3	6	
Student 6	3	7		5	4	6	5	6	5	5	2	3	7	4		4	4		1	
Student 7			10	2	5	5	6	5	5	6	3	3	7	2		6	2	3	7	
Student 8			10	6	2	5	5	5	5	7	3		6	2	5	4		2	5	
Student 9	3		11	5		3	5	5	6	5	0		6	5	3	2			3	
Student 10			11	4	5	2	5	5	5	4	0			5	5	5	5		1	

Fig. 3.6: CO Attainment – Semester End Examination

Fig. 3.6: CO Attainment – Semester End Examination

- In the Fig. 3.6, it is clear that CO1 contributes for 3 question parts, CO2 contributes for 4 question parts, CO3 contributes for 4 parts, CO4 contributes for 4 parts and CO5 contributes for 4 parts.
- The final Course Outcome calculation for CO1 to CO5 will be the average of all the CO attainment values from the Individual Question parts, similar to the process in the Sessional Examination.

The specimen calculation is shown in Fig 3.7.

ADITYA ENGINEERING COLLEGE(A)																			
EXTERNAL EXAM DATA																			
BRANCH	<Branch>				REGULATION														
COURSE NAME	Course 1				COURSE CODE		<Course Code>												
COURSE INSTRUCTOR	< Faculty Name>																		
	Q1		Q2	Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
	A	B	A	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Max.Marks	4	8	12	6	6	6	6	6	6	8	4	4	8	6	6	6	6	4	8
COURSE OUTCOME	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO4	CO4	CO4	CO4	CO5	CO5	CO5	CO5
Student 1			7	3	3					2	3	3	4	1				3	4
Student 2			2		2		2				1		4						
Student 3			12		3	5	5	6	5					5	5				4
Student 4	3	6		4	4	4	4			5	3			5	5	5	5		
Student 5	0		10	4	5	3	3			4	3	2	6					3	
Student 6			11	5	4	5	5	5	5				6			5	5		
Student 7	3	7		4	5	5	6	6	5					5	5			3	6
Student 8			11	5		6	6	6	6					3	3			1	1
Student 9			8	4	6	4	4	3					3					2	
Student 10			11	5	6	6	5	6	5				2	5	5			2	5

TARGET PERCENTAGE in CO (Instructor fixed)	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%
MARKS SATISFYING TARGET PERCENTAGE	2.4	4.8	7.2	3.6	3.6	3.6	3.6	3.6	3.6	4.8	2.4	2.4	4.8	3.6	3.6	3.6	3.6	2.4	4.8
NO. OF STUDENTS >= TARGET PERCENTAGE	2	2	6	7	6	7	7	5	5	1	3	1	2	4	4	2	2	3	2
COURSE OUTCOME	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO4	CO4	CO4	CO4	CO5	CO5	CO5	CO5
CO ATTAINMENT %	67%	100%	75%	88%	67%	88%	78%	83%	100%	33%	75%	50%	33%	67%	80%	100%	100%	50%	40%
Attainment levels results	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO4	CO4	CO4	CO4	CO5	CO5	CO5	CO5
CO ATTAINMENT LEVEL	1	3	2	3	1	3	2	3	3	0	2	0	0	1	3	3	3	0	0

ANALYSIS OF ATTAINMENTS	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO4	CO4	CO4	CO4	CO5	CO5	CO5	CO5	FINAL ATTAINMENT VALUE
CO1	1	3	2																	2.00
CO2				3	1	3	2													2.25
CO3								3	3	0	2									2.00
CO4												0	0	1	3					1.00
CO5																3	3	0	0	1.50

Fig. 3.7: CO attainment (SEE) Calculation and Results

Fig. 3.7: CO attainment (SEE) Calculation and Results

- From the above calculation data in Fig. 3.7 it is clear that Final Attainment values of CO1 to CO5 are as under.

CO1 : Average of 1, 3 and 2 = 2.00

CO2: Average of 3, 1, 3 and 2 = 2.25

CO3: Average of 3, 3, 0 and 2 = 2.00

CO4: Average of 0, 0, 1 and 3 = 1.00

CO5: Average of 3, 3, 0 and 0 = 1.50

CONSOLIDATED COURSE OUTCOME ATTAINMENT CALCULATION

The calculations of various components of CO Attainment will be as under:

Sessional CO Attainment

= Maximum (CO Attainment in Sessional 1, CO Attainment in Sessional 2)

(If a particular CO appears either of Sessional 1 or Sessional 2)

= Average (CO Attainment in Sessional 1, CO Attainment in Sessional 2)

(If a particular CO appears in both Sessional 1 and Sessional 2)

Direct CO Attainment = 40% (Sessional Examinations) + 60% (Semester End Examination)

Total CO Attainment = 90% (Direct CO Attainment) + 10% (Indirect CO Attainment)

Sample calculation for a course is shown as specimen below.

Sample calculation for a course is shown as specimen below:

ADITYA ENGINEERING COLLEGE(A)								
TOTAL COURSE OUTCOME(CO) ATTAINMENT								
ACADEMIC YEAR				SEMESTER				
BRANCH	<Branch>			REGULATION				
COURSE	Course 1			COURSE CODE	<Course Code>			
COURSE INSTRUCTOR	<Faculty Name>							
COURSE ARTICULATION MATRIX								
ANALYSIS OF ATTAINMENTS	S1	S2	CO ATTAINMENT Sessionals	CO ATTAINMENT External Exams	DIRECT CO ATTAINMENT	INDIRECT CO ATTAINMENT	TOTAL CO ATTAINMENT	CO ATTAINMENT %
CO1	0.00	0.00	0.00	2.00	1.20	2.66	1.35	44.87%
CO2	0.17	0.00	0.17	2.25	1.42	2.53	1.53	50.92%
CO3	0.00	2.00	2.00	3.00	2.60	2.52	2.59	86.39%
CO4	0.00	1.33	1.33	2.25	1.88	2.55	1.95	64.96%
CO5	0.00	1.33	1.33	2.50	2.03	2.50	2.08	69.29%
COURSE CO ATTAINMENT							1.90	63.28%

Fig. 3.8: Total CO Attainment

Fig. 3.8: Total CO Attainment

Course CO attainment will be the average of CO attainments of all the Course outcomes i.e., 1.96 in the above example.

3.7. BRIDGING THE CO ATTAINMENT GAP

The specimen for CO attainment gap analysis is shown in Fig. 3.9.

ADITYA ENGINEERING COLLEGE(A)					
BRIDGING THE CO ATTAINMENT GAP					
ACADEMIC YEAR			SEMESTER		
BRANCH	<Branch>		REGULATION		
COURSE	Course 1		COURSE CODE	<Course Code>	
COURSE INSTRUCTOR	<Faculty Name>				
ANALYSIS OF ATTAINMENTS	CO TARGET %	CO ATTAINMENT %	CO ATTAINMENT GAP (Attainment-Target) %	Action proposed to bridge the Gap	Modification of target where achieved
CO1	60.00%	44.87%	-15.13%	More assignments are suggested	-
CO2	60.00%	50.92%	-9.08%	More tutorials are suggested. Data book Practice is to be verified for each student	-
CO3	60.00%	86.39%	26.39%	-	Same target for next batch
CO4	60.00%	64.96%	4.96%	-	Same target for next batch
CO5	60.00%	69.29%	9.29%	-	Same target for next batch
Signature of the Course Instructor					
Name & Signature of Course Coordinator					
Name & Signature of HOD					

Fig. 3.9 : CO Attainment – Gap Analysis

MAPPING STRENGTH :

A sample CO-PO-PSO articulation matrix is shown in Table 3.2.

Table 3.2: CO-PO-PSO ARTICULATION MATRIX

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												1
CO2	3	1												1
CO3	3	1												1
CO4	3	1												1
CO5	3	1												1
MAPPING STRENGTH	3.00	1.00												1.00

In the specimen, the mapping strength of PO1, PO2 and PSO2 are 3.00, 1.00 and 1.00 respectively.

DIRECT PO/PSO ATTAINMENT FOR A LEARNING BATCH CALCULATION

A sample PO/PSO Attainment is shown as Table 3.3 below.

Table 3.3: PO/PSO Attainment Calculation

COURSE OUTCOME	TOTAL CO ATTAINMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1.35	1	1	0	0	0	0	0	0	0	0	0	0	0	1
CO2	1.53	1	1	0	0	0	0	0	0	0	0	0	0	0	1
CO3	2.59	1	1	0	0	0	0	0	0	0	0	0	0	0	1
CO4	1.95	1	1	0	0	0	0	0	0	0	0	0	0	0	1
CO5	2.08	1	1	0	0	0	0	0	0	0	0	0	0	0	1
DIRECT PO ATTAINMENT	(Mapping Strength/3)* AVERAGE OF MAPPED Course Outcomes	1.90	0.63												0.63

The 1's and 0's in the table refers to whether the particular PO is mapped to that CO or not mapped. '1' indicates mapped, '0' indicates not mapped.

The final PO attainment is displayed in the last row stating it as DIRECT PO ATTAINMENT.

CALCULATION OF INDIRECT PO/PSO ATTAINMENT

Indirect PO attainment calculation will be done through Survey Reports, by taking arithmetic average of all the attainment values for PO1 to PO12 and PSO's.

A sample report is shown in Fig. 3.10.

ALUMNI SURVEY	2.52	2.47	2.59	2.20	2.30	2.20	2.36	2.44	2.00	2.24	2.46	2.00	2.00	2.00
EMPLOYER SURVEY	3.00	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.80	2.80	2.80	2.60	2.80	2.60
PARENTS' SURVEY	2.42	2.25	2.54	2.40	2.37	2.46	2.46	2.37	2.34	2.38	2.39	2.00	2.00	2.00
PROGRAM EXIT SURVEY	2.51	2.42	2.45	2.43	2.41	2.46	2.42	2.48	2.47	2.49	2.47	2.44	2.49	2.40
INDIRECT PO ATTAINMENT (Survey Reports)	2.61	2.44	2.55	2.41	2.42	2.43	2.46	2.47	2.40	2.48	2.53	2.26	2.32	2.25

Fig. 3.10 : Indirect Survey Reports-Calculation of Indirect PO Attainment

3.8 COMPLETE PO/PSO ATTAINMENT CALCULATION

The specimen calculation process for final PO/PSO attainment is shown in Fig. 3.11 below.

ADITYA ENGINEERING COLLEGE(A)															
PROGRAM OUTCOME ATTAINMENT STATEMENT															
BRANCH									REGULATION						
YEAR OF ADMISSION															
COURSE CODE	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
101	Course 1	1.04	0.85	0.66	0.46									1.23	
201	Course 2	1.32	1.97	2.96	1.97	2.96	1.98	1.98	1.97	0.99	1.97	0.99	0.99	1.18	0.99
301	Course 3	1.48	0.98	0.98	0.98	1.97	0.98	0.98	1.97	0.98	0.98	0.98	0.98	1.48	0.98
401	Course 4	1.03	0.51	0.57									0.43	0.86	
501	Course 5	2.45	0.98							1.96	0.98			2.21	
601	Course 6	2.70				2.21				1.96	1.96			1.96	
DIRECT PO ATTAINMENT (Assessment Reports)		1.67	1.06	1.29	1.14	2.38	1.48	1.48	1.97	1.47	1.47	0.99	0.80	1.49	0.99
ALUMNI SURVEY		2.52	2.47	2.59	2.20	2.30	2.20	2.36	2.44	2.00	2.24	2.46	2.00	2.00	2.00
EMPLOYER SURVEY		3.00	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.80	2.80	2.80	2.60	2.80	2.60
PARENTS' SURVEY		2.42	2.25	2.54	2.40	2.37	2.46	2.46	2.37	2.34	2.38	2.39	2.00	2.00	2.00
PROGRAM EXIT SURVEY		2.51	2.42	2.45	2.43	2.41	2.46	2.42	2.48	2.47	2.49	2.47	2.44	2.49	2.40
INDIRECT PO ATTAINMENT (Survey Reports)		2.61	2.44	2.55	2.41	2.42	2.43	2.46	2.47	2.40	2.48	2.53	2.26	2.32	2.25
EQUIVALENT INDIRECT PO ATTAINMENT		1.99	1.50	1.41	1.12	1.82	1.42	1.64	2.06	1.39	1.63	1.35	0.96	1.77	0.96
FINAL PROGRAM OUTCOME ATTAINMENT (90% of Direct Attainment + 10% of Indirect Attainment)		1.70	1.10	1.30	1.14	2.32	1.47	1.50	1.98	1.46	1.49	1.02	0.82	1.52	0.98

Fig. 3.11: Final PO Attainment Calculation

3.9. BRIDGING THE PO/PSO ATTAINMENT GAP

Similar to the academic learning gap in the case of Course Outcome, Program Outcome/ Program Specific Outcome Gap will be also be calculated based on the fact that Graduate Attributes Gaps need to be identified and remedial action need to be initialized.

A specimen report of PO/PSO attainment Gap is shown in Fig. 3.12.

DIRECT PO ATTAINMENT (Assessment Reports)	1.67	1.06	1.29	1.14	2.38	1.48	1.48	1.97	1.47	1.47	0.99	0.80	1.49	0.99
ALUMNI SURVEY	2.52	2.47	2.59	2.20	2.30	2.20	2.36	2.44	2.00	2.24	2.46	2.00	2.00	2.00
EMPLOYER SURVEY	3.00	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.80	2.80	2.80	2.60	2.80	2.60
PARENTS' SURVEY	2.42	2.25	2.54	2.40	2.37	2.46	2.46	2.37	2.34	2.38	2.39	2.00	2.00	2.00
PROGRAM EXIT SURVEY	2.51	2.42	2.45	2.43	2.41	2.46	2.42	2.48	2.47	2.49	2.47	2.44	2.49	2.40
INDIRECT PO ATTAINMENT (Survey Reports)	2.61	2.44	2.55	2.41	2.42	2.43	2.46	2.47	2.40	2.48	2.53	2.26	2.32	2.25
EQUIVALENT INDIRECT PO ATTAINMENT	1.99	1.50	1.41	1.12	1.82	1.42	1.64	2.06	1.39	1.63	1.35	0.96	1.77	0.96
FINAL PROGRAM OUTCOME ATTAINMENT (90% of Direct Attainment + 10% of Indirect Attainment)	1.70	1.10	1.30	1.14	2.32	1.47	1.50	1.98	1.46	1.49	1.02	0.82	1.52	0.98
PO MAPPING STRENGTH	2.29	1.85	1.66	1.40	2.26	1.75	2.00	2.50	1.73	1.97	1.60	1.27	2.29	1.28
PROGRAMME OUTCOME GAP	0.59	0.75	0.36	0.26	-0.06	0.28	0.50	0.52	0.27	0.48	0.58	0.45	0.77	0.30

Fig. 3.12 : PO/PSO Attainment Gap

