OUTCOME BASED TEACHING & LEARNING

IARE
INSTITUTE OF AERONAUTICAL ENGINEERING

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Preamble

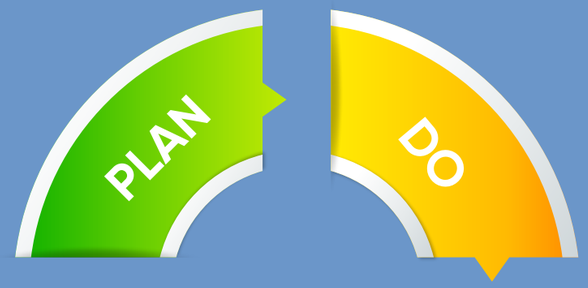
Outcome-based teaching and learning (OBTL) is an educational theory that focuses on achieving specific goals and outcomes for students. It's a student-centered approach that involves restructuring curriculum, assessment, and reporting practices to reflect mastery and high-order learning rather than course credits. OBTL emphasizes what the learner should get out of the teaching, rather than what the teacher intends to teach.

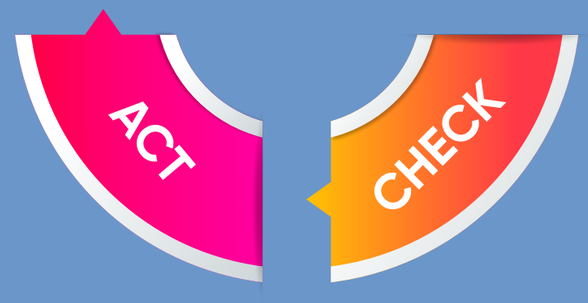
Objectives

The outcome based teaching learning center is to facilitate the faculty and the students in achieving processes that enable implementation of outcome based education (OBE) and state-of-the-art pedagogy and using latest technology

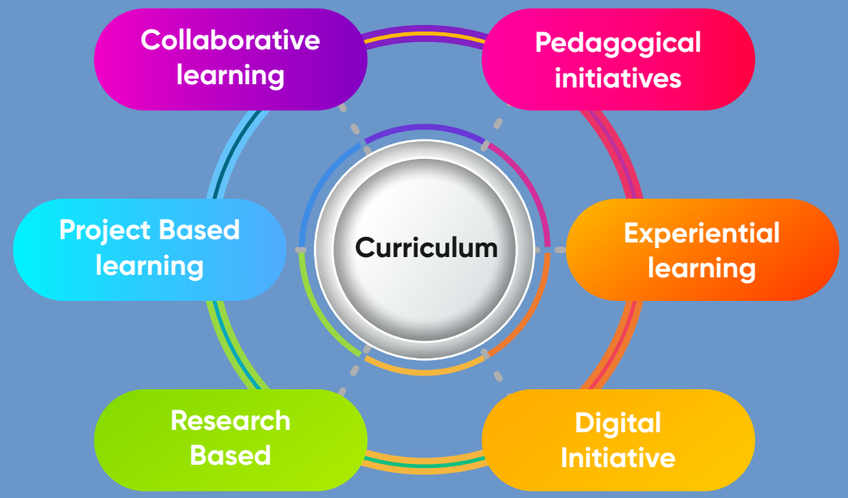
- Assist Course Coordinators in Designing Course Description /Template.
- Provide Training To The Faculty Members In Delivering State-Of-The-Art Lectures By Improving Pedagogy And Using Latest Technology.
- Support The Students In The Self And Peer Learning Process To Ensure Conceptualization And Meaningful Learning.

Outcome Based Teaching & Learning Frame Work



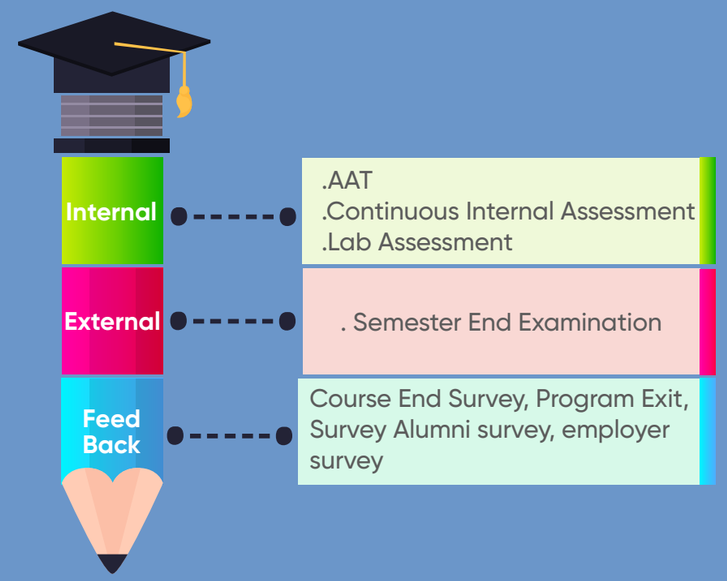


Teaching Learning Process

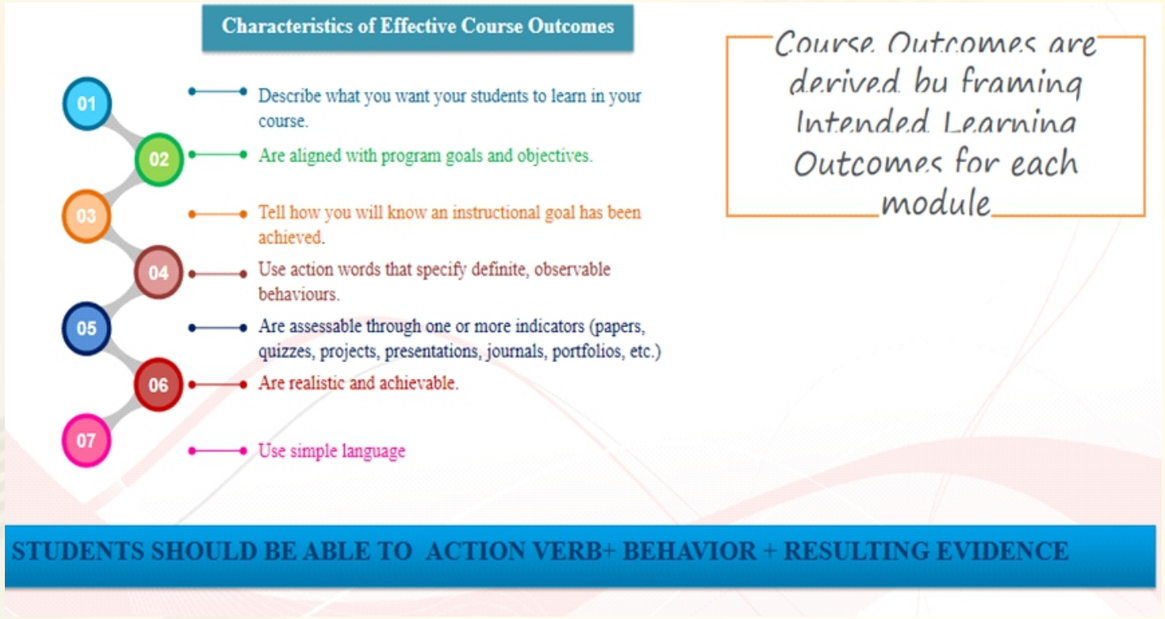


Continuous Improvement

Assessment Methods



Development of Course Outcomes



Process of CO-PO Mapping

STEP 1

Obtain course outcome

STEP 2

Mapping of course outcome with program outcome

STEP 3

Setting weightage for CO assessment

STEP 4

CO measurement through assessment

STEP 5

Obtain CO attainment table through direct and indirect assessment methods

STEP 6

Obtain PO attainment table through direct and indirect assessment methods

Program Outcomes (POs)

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 teamwork

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 & 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.

Key Attributes for Assessing Program Outcomes

PO-1 Engineering Knowledge

Knowledge, understanding and application of
- ❖ Scientific principles and methodology
- ❖ Mathematical principles
- ❖ Own and / or other engineering disciplinesto integrate / supportstudy of their own engineering discipline

PO-2 Problem Analysis

- ❖ Problem or opportunity identification
- ❖ Problem statement and system definition
- ❖ Problem formulation and abstraction
- ❖ Information and data collection
- ❖ Model translation
- ❖ Validation
- ❖ Experimental design
- ❖ Solution development or experimentation / Implementation
- ❖ Interpretation of results
- ❖ Documentation

PO-3 Design/Development of Solutions

❖ Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues;
❖ Understand customer and user needs and the importance of considerations such as aesthetics;
❖ Identify and manage cost drivers;
❖ Use creativity to establish innovative solutions;
❖ Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal;
❖ Manage the design process and evaluate outcomes.
❖ Knowledge and understanding of commercial and economic context ofengineering processes;
❖ Knowledge of management techniques which may be used to achieve engineering objectives within that context;
❖ Understanding of the requirement for engineering activities to promote sustainable development;
❖ Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues;

PO-4 Conduct Investigations of Complex Problems

❖ Knowledge of characteristics of particular materials, equipment, processes, or products;
❖ Workshop and laboratory skills;
❖ Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.);
❖ Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues;
❖ Understanding of appropriate codes of practice and industry standards;
❖ Awareness of quality issues;
❖ Ability to work with technical uncertainty.
❖ Understanding of engineering principles and the ability to apply them to analyse key engineering processes;
❖ Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques;
❖ Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems;
❖ Understanding of and ability to apply a systems approach to engineering problems.

PO-5 Engineering Tool Usage

❖ Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.

PO-6 The Engineer and Society

❖ Knowledge and understanding of commercial and economic context of engineering processes;
❖ Knowledge of management techniques which may be used to achieve engineering objectives within that context;
❖ Understanding of the requirement for engineering activities to promote sustainable development;
❖ Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues;
❖ Understanding of the need for a high level of professional and ethical conduct in engineering.

PO-7 Environment and Sustainability

Impact of the professional Engineering solutions (Not technical)
- ❖ Socio economic,
- ❖ Political and
- ❖ Environmental

PO-8 Ethics

- ❖ Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior.
- ❖ Stood up for what they believed in
- ❖ High degree of trust and integrity

PO-9 Individual and Teamwork

- ❖ Independence
- ❖ Maturity – requiring only the achievement of goalsto drive their performance
- ❖ Self-direction (take a vaguely defined problem and systematically work to resolution)
- ❖ Teams are used during the classroom periods, in the hands-on labs, and in the design projects.
- ❖ Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.
- ❖ Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference.
- ❖ Teamwork is important not only for helping the students know their classmates but also in completing assignments.
- ❖ Students also are responsible for evaluating each other's performance, which is then reflected in the final grade.
- ❖ Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation.
- ❖ Ability to work with all levels of people in an organization
- ❖ Ability to get along with others
- ❖ Demonstrated ability to work well with a team

PO-10 Communication

"Students should demonstrate the ability to communicate effectively in writing / Orally."
- ❖ Clarity (Writing)
- ❖ Grammar/Punctuation (Writing)
- ❖ References (Writing)
- ❖ Speaking Style (Oral)
- ❖ Subject Matter (Oral)

PO-11 Project Management and Finance

- ❖ Scope Statement
- ❖ Critical Success Factors
- ❖ Deliverables
- ❖ Work Breakdown Structure
- ❖ Schedule
- ❖ Budget
- ❖ Quality
- ❖ Human Resources Plan
- ❖ Stakeholder List
- ❖ Communication
- ❖ Risk Register
- ❖ Procurement Plan

PO-12 Life - Long Learning

- ❖ Project management professional certification / MBA
- ❖ Begin work on advanced degree
- ❖ Keeping current in CSE and advanced engineering concepts
- ❖ Personal continuing education efforts
- ❖ Ongoing learning – stays up with industry trends/ new technology
- ❖ Continued personal development
- ❖ Have learned at least 2-3 new significant skills
- ❖ Have taken up to 80 hours (2 weeks) training per year

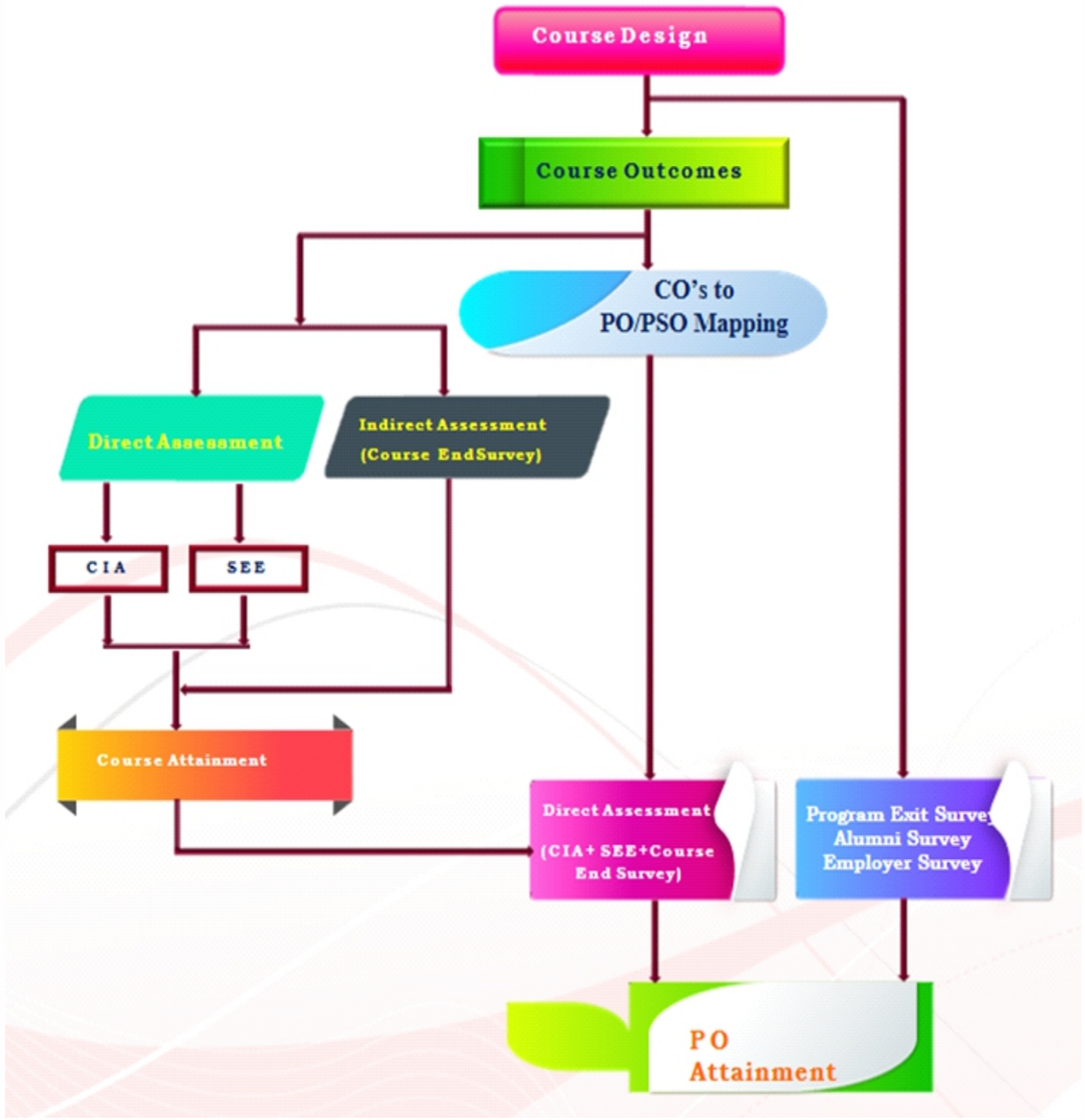
Course Outcome Mapping With Po/ Pso

CO No.	CO Statements
CO1	Relate the different physical and mechanical systems into equivalent electrical analogies using the mathematical form of complex physical systems.
C02	Utilize various reduction techniques for developing the transfer function and steady state error with the standard input signals.
CO3	Make use of the time domain analysis to predict transient response specifications for analyzing system's stability
C0.4	Infer the stability of a first and second order systems using frequency domain specifications.
CO5	Classify the types of compensators in time domain and frequency domains specifications for increasing the steady state accuracy of the system.
CO6	Interpret linear system equations in state-variable form for the analysis of system's dynamic behavior.

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	-	-	-	1	-	1	-	-	1
C02	3	3	2	1	-	2	-	1	-	1	-	1	2	-	-
CO3	3	3	3	1	-	1	-	-	-	-	-	-	1	-	-
C0.4	3	2	2	3	-	1	-	-	-	-	-	-	-	1	-
CO5	3	2	2	3	-	2	-	1	-	1	-	1	2	2	-
CO6	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-

Maximum Given Key Attributes (in Percentage)	Co-relation rubrics	Comment
0 ≦ C ≦ 5%	0	No correlation.
5 < C ≦ 40%	1	Low / Slight.
40% < C < 60%	2	Moderate
60% ≦ C < 100%	3	High

CO-PO/PSO attainment Process



Course outcomes

A course outcome refers to the specific skills, knowledge, or competencies that students are expected to achieve upon completing a course. Course outcomes are measurable and clearly defined, helping both instructors and students understand the goals of the course and the expected achievements

- ❖ Key Components of a Course Outcome:
- ❖ Clear Objectives
- ❖ Measurable
- ❖ Aligned with Learning Activities
- ❖ Action-Oriented

Mechanism for the attainments of Course outcome

$$\text{CO Attainment (CIE or SEE)} = \frac{\text{No. of students reached (threshold) in answering the question}}{\text{No. of students attempted}} * 100$$

Overall CO attainment (Direct): 0.30 * CIA + 0.70 * SEE

$$\text{CO Attainment (Inirect)} = \frac{\text{No. of students responses reached expected level in answering the survey}}{\text{No. of students responded}} * 100$$

Weightage of attainment level

- Direct level 80%
- Indirect level 20%

CO Attainment

0.8 * CO attainment (Direct)
+
0.2 * CO attainment (indirect)

	Assessment	Tools	Weight
CO Attainment	Direct Assessment	CO attainment of courses	80%
	Indirect Assessment	Course End Survey	20%

PO/PSO Attainment

PO (Program Outcomes) and PSO (Program Specific Outcomes) represent specific learning outcomes that students are expected to achieve by the end of their academic program.
Program Outcomes are general skills or competencies that graduates of a program are expected to acquire. POs are not tied to a specific discipline but are common across various programs. They generally align with the attributes needed for professional and personal success.
Program Specific Outcomes are tailored to a particular program or discipline. They define what a graduate of a specific program (e.g., Mechanical Engineering, Computer Science, etc.) should be able to do. PSOs focus on knowledge and skills directly related to the field of study.
Attainment of PO and PSO:
Attainment refers to the measurement of how well the students have achieved these outcomes. This is typically done using various assessment tools such as:
Direct assessments: Examinations, projects, assignments, lab work.
Indirect assessments: Surveys, feedback from alumni, employer feedback.
PO/PSO ATTAINMENT

The performance of students in these assessments is mapped to the predefined POs and PSOs, and the attainment levels are calculated to check if the expected learning outcomes have been achieved.

Mechanism for the attainments of PO/PSO

$$\text{Arttainment } PO_j = \frac{\sum_{i=0}^{K} PO_{ij}}{\text{Number of Courses Achieved}} \qquad j = 1,2,3, \ldots, 12$$

$$\text{Arttainment } PO_j = \frac{\sum_{i=0}^{K} PO_{ij}}{\text{Number of Courses Achieved}} \qquad j = 1,2,3, \ldots, 12$$

$$\text{Arttainment } PSO_j = \frac{\sum_{i=0}^{K} PSO_{ij}}{\text{Number of Courses Achieved}} \qquad j = 1,2,3$$

	Assessment	Tools	Weight
PO & PSO Attainment	Direct Assessment	CO attainment of courses	80%
	Indirect Assessment	Program Exit Survey	20%
		Alumni Survey	
		Alumni Survey	

Final attainment of PO / PSO =
80% of direct assessment of CO + 10% of Program Exit Survey + 5% of Alumni Survey + 5% of Employer Survey

Pos / PSOs Overall Attainment

S.No.	Course Code	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	15EE206	Digital System Design	3	2	2	-	1	1	1	-	-	-	-	-
2	15EE209L	Analog and Digital Circuits Laboratory	3	2.67	2.75	2	-	-	-	-	-	-	-	-
3	15EE211	Control Systems	3	3	3	-	2	1	-	-	-	-	-	-
4	15EE212L	Measurements and Control Systems Laboratory	3	-	-	1.67	-	1	-	-	-	-	-	-
5	15EE301J	Power Electronics	3	3	-	-	-	1	1	-	-	-	-	-
6	15EE303	Discrete Transforms and Signal Processing	3	3	1.5	-	-	1	1	-	-	-	-	-
7	15EE305J	Microcontrollers	3	2	2	-	2	-	-	-	-	-	-	-
8	15EE306M	Multi-Disciplinary Design	3	2	3	-	-	-	-	1	-	-	-	1.5
9	15EE401	Solid State Drives	3	2.33	2	-	-	1	1	-	-	-	-	-
10	15EE496L	Major Project	3	3	3	-	-	3	-	3	3	3	3	3

Pos / PSOs Overall

S. No	Assessment Component (Direct +Indirect)	PO												PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Direct Assessment (CIA + SEE + Course End Survey) (a)	1.93	1.90	1.87	1.83	1.99	2.00	1.88	1.98	1.96	1.89	2.05	1.86	1.85	1.88	2.1
2.	Student Program exit surveys(b)	2.2	2.2	1.9	1.9	2.2	1.8	2	2.2	2.2	1.8	2.1	1.8	1.9	1.8	2
3.	Employer surveys(c)	2.1	2.1	1.8	1.8	2	1.8	1.8	2.0	2.1	1.8	2.1	1.8	1.8	1.9	2.1
4.	Alumni Survey(d)	2.2	2	1.8	1.9	2.1	1.8	1.8	2.1	1.9	1.8	2	1.8	1.9	1.8	2.2
	Final attainment = a*0.8 + b*0.1 + c*0.05 + d*0.05	1.98	1.95	1.87	1.84	2.02	1.96	1.88	2.01	1.99	1.87	2.06	1.85	1.86	1.87	2.06

Assesment Tool (ESLO)

ESLO - Evaluation of Students Learning Outcomes Portal
ESLO is a tool developed for assessment of Outcome-Based Education (OBE), a student centric teaching learning methodology in which the course delivery and assessment planned is achieved with stated objectives and outcomes. The ESLO tool inputs are student-outcomes statistics and are often "output-only" measures. That is, they are computed without regard to incoming student differences and without regard to how different students experienced the college environment. As a result, they do not distinguish how much an observed measurement is the product of the institution and its programs on students, and how much is due to other factors, such as socioeconomic status, general intelligence, or which high school was attended. Student Learning Outcomes are measurable statements about what the students should know or be able to do upon completion of the course or program.
The ESLO can be used generate annual assessment report that describes the learning outcomes conducted that year and how they have used the results for program improvement.

CO attainment Process in ESLO

STEP 1
CO Entry

STEP 2
PO / PSO Applicability

STEP 3
CIE Question Paper Entry (CIE – I & CIE – II)

STEP 4
SEE Question Paper Entry

STEP 5
Course Articulation matrix mapping with CO to PO/PSOs

STEP 6
Fixing the threshold value

STEP 7
Direct assessment based on the course CIE & SEE (80%)

STEP 8
Indirect assessment i.e Course End Survey (20%)

STEP 9
Action taken report for the course

PO/PSO Attainment Process in ESLO

STEP 1
Program articulation matrix are mapped with course to PO / PSO

STEP 2
Threshold for each course are fixed while calculating the co-attainment.

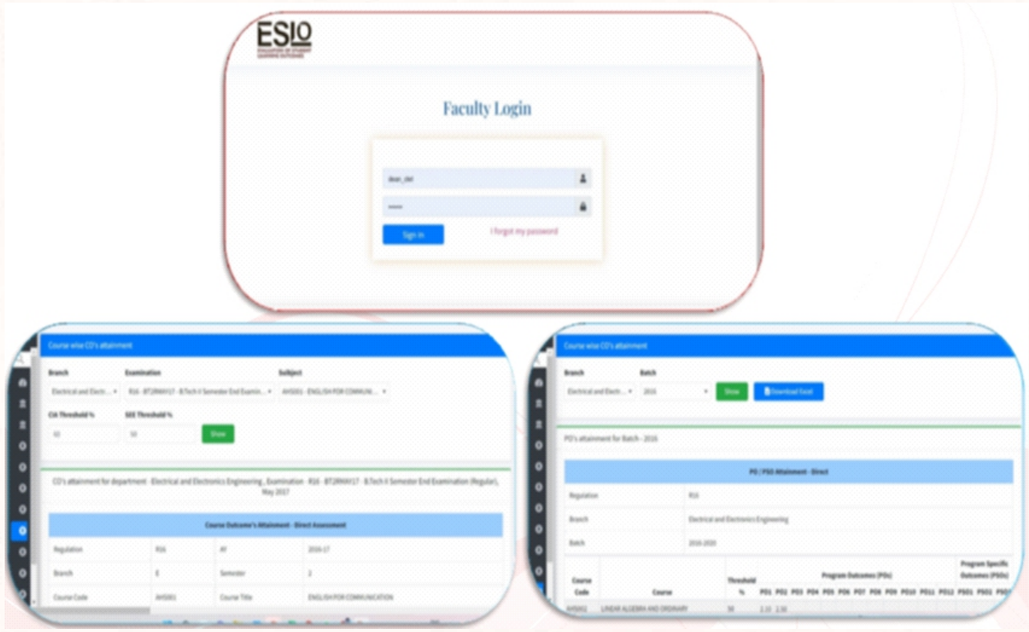
STEP 3
Assessment component for calculating PO attainment are direct assessment of CIA + SEE + Course End Survey (10%)

STEP 4
Indirect assessment components are program exist survey (5%) and Alumini Survey (5%)

STEP 5
PO & PSOs attainment levels are measured & action taken report are prepared for the continuous improvement.

ESLO Evaluation of student learning outcomes platform login

https://eslo.iare.ac.in/



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