IARE

EDUCATION FOR LIBERATION

WORKSHOP ON

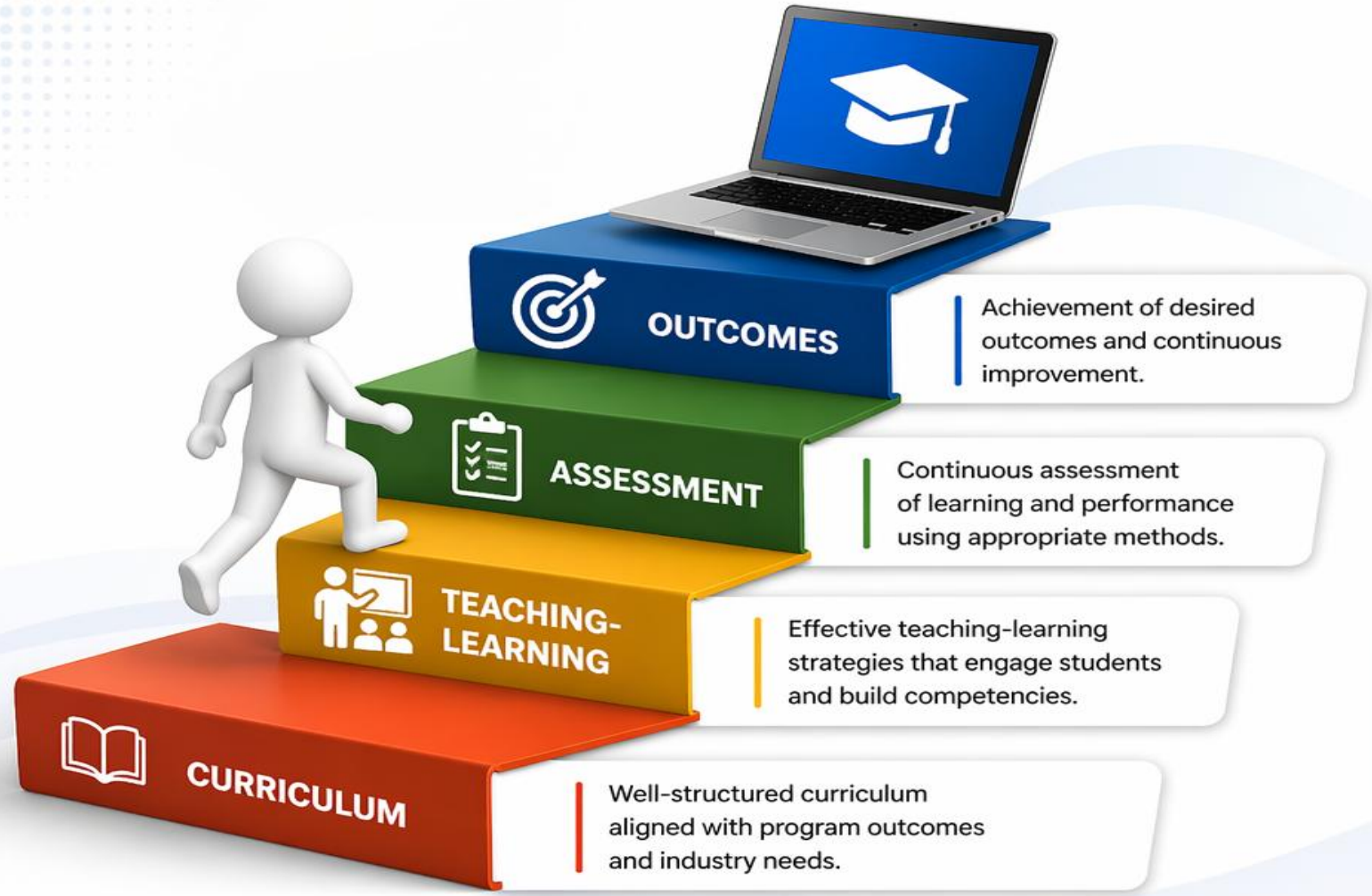
OUTCOME BASED EDUCATION

OUTCOMES TODAY, EXCELLENCE TOMORROW

SCAN TO ACCESS THIS PRESENTATION

OUTCOME BASED EDUCATION

A holistic approach that focuses on what students should know, be able to do, and value by the end of their learning experience.



OUR GOAL

Empowering learners to achieve meaningful outcomes and succeed in a dynamic world.

BENEFITS OF OUTCOME BASED EDUCATION

- Focus on meaningful learning and real-world application
- Enhances student engagement and responsibility
- Ensures quality and accountability in education
- Drives continuous improvement in teaching and programs
- Develops competent, industry-ready and future-ready graduates

ALIGNING GRADUATE ATTRIBUTES AND PROFESSIONAL COMPETENCIES (GAPC 4.0)

WITH NBA & OBE

01 COMPLEX ENGINEERING PROBLEM
Ability to identify, formulate, analyze and solve complex engineering problems.

02 SUSTAINABLE DEVELOPMENT GOALS (SDGS)
Understanding of the SDGs and ability to contribute to a sustainable future.

03 INDIAN KNOWLEDGE SYSTEM
Appreciation and integration of Indian knowledge traditions in engineering education and practice.

04 HOLISTIC EDUCATION FOR HOLISTIC DEVELOPMENT
Development of mind, body and character for a balanced and fulfilling life.

05 MULTIDISCIPLINARY
Ability to work across disciplines and leverage knowledge from diverse fields.

06 ENTREPRENEURSHIP
Ability to innovate, take initiative and create value through entrepreneurial mindset.

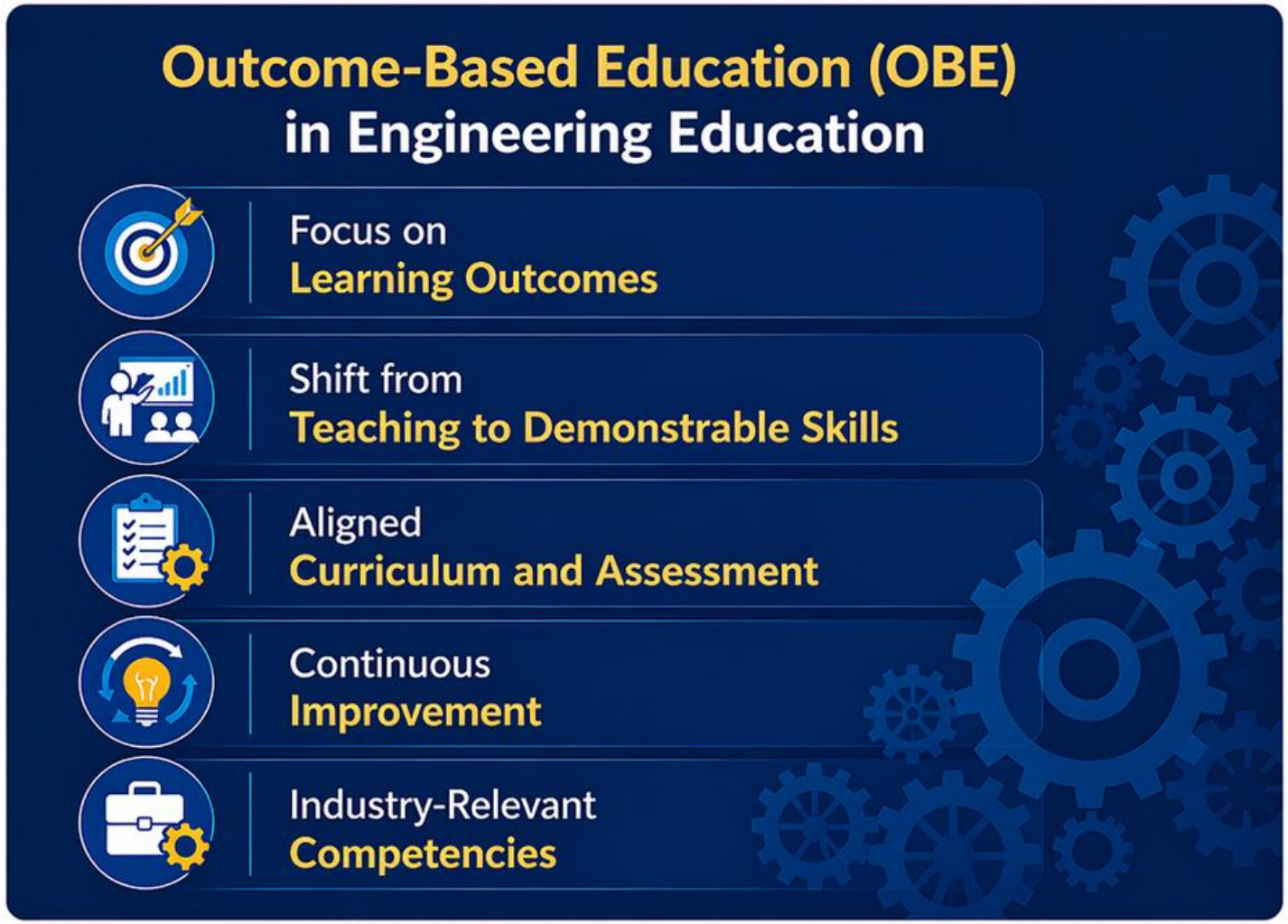
07 SOCIAL INTERNSHIP
Engagement with society to understand real-world issues and contribute to community development.

08 INSTITUTIONAL DEVELOPMENT PLAN
Commitment to quality enhancement through planning, implementation and continuous improvement.

09 MULTI-ENTRY AND MULTI-EXIT
Flexible academic pathways with multiple entry and exit options for lifelong learning.

10 RUBRICS
Clear criteria and standards for assessment and evaluation of learning outcomes.

OUTCOMES-BASED EDUCATION (OBE)



Outcome-Based Education (OBE) in engineering colleges is a learner-centric pedagogical framework that shifts the focus from traditional teaching inputs (syllabus coverage) to tangible learning outcomes (what students can actually do)

OUTCOME BASED EDUCATION-STEPS

OBE shifts from measuring input and process to include **measuring the output (outcome).**

INPUT → PROCESS → (SHORT-TERM) PROGRAMME OUTCOMES (POs) → (LONG-TERM) PROGRAM EDUCATION OBJECTIVES (PEOs)

Teaching Staff
Curriculum
Labs
Other Resources

- Teaching Staff
- Curriculum
- Labs
- Other Resources

Teaching & Learning

Teaching & Learning

Students at Graduation

- Assessment by exams, tests and assignments.
- Assessment of teaching staff, lecture material & flow, results and student 'capabilities' (Short & long-term outcomes), lab interview, exit survey etc.
- More 'thinking' projects, with analysis.
- Feedback from industry, alumni and other stakeholders.
- Clear continuous improvement step.

Graduates to Fulfill Stakeholders' Satisfaction

Stakeholders:

- O/REN/NUC employers
- Industry Advisors
- Academic Staff
- Public and Parents
- Students
- Alumni

OUTCOME-BASED EDUCATION FOCUSES

on measuring student learning outcomes rather than only teaching inputs and processes.

HOW TEACHING, ASSESSMENT, AND STAKEHOLDER FEEDBACK

contribute to achieving program outcomes and long-term educational objectives.

Organizations / Recruiters / Entrepreneurs / National bodies (NUC)

OUTCOME-BASED EDUCATION PYRAMID

A FRAMEWORK FOR LEARNER SUCCESS

THE OBE PYRAMID (THE 5P's)

1 **What** and **whether** students learn successfully is more important than **when** and **how** they learn something.

2
1. Equip students with the **knowledge, competence, and qualities** to be successful after they exit the education system.
2. Structure and operate **School of Engineering** so that the desired outcomes are **achieved/maximized for all students**.

3
1. All students can learn but not in the same time/same way.
2. Successful learning breeds more successful learning.
3. **School of Engineering** controls the conditions that direct learning.

4
1. **Clarity** of focus on exit outcomes of significance.
2. **Expanded opportunity**/support for learning success.
3. **High expectations** for all to succeed.
4. **Design down** from culminating outcomes.

1	2	3	4	5
Define outcomes	Design curriculum	Deliver instruction	Document results	Determine advancement

THE OBE PYRAMID (5P's) GUIDES OUTCOME-BASED EDUCATION THROUGH

- PARADIGM
- PURPOSES
- PREMISES
- PRINCIPLES
- PRACTICES

TRANSFORMING EDUCATION. EMPOWERING STUDENTS.

OUTCOMES • EXCELLENCE • EQUITY

OUTCOMES-BASED EDUCATION – 3 PILLARS

01 OUTCOMES-BASED EDUCATION PHILOSOPHY

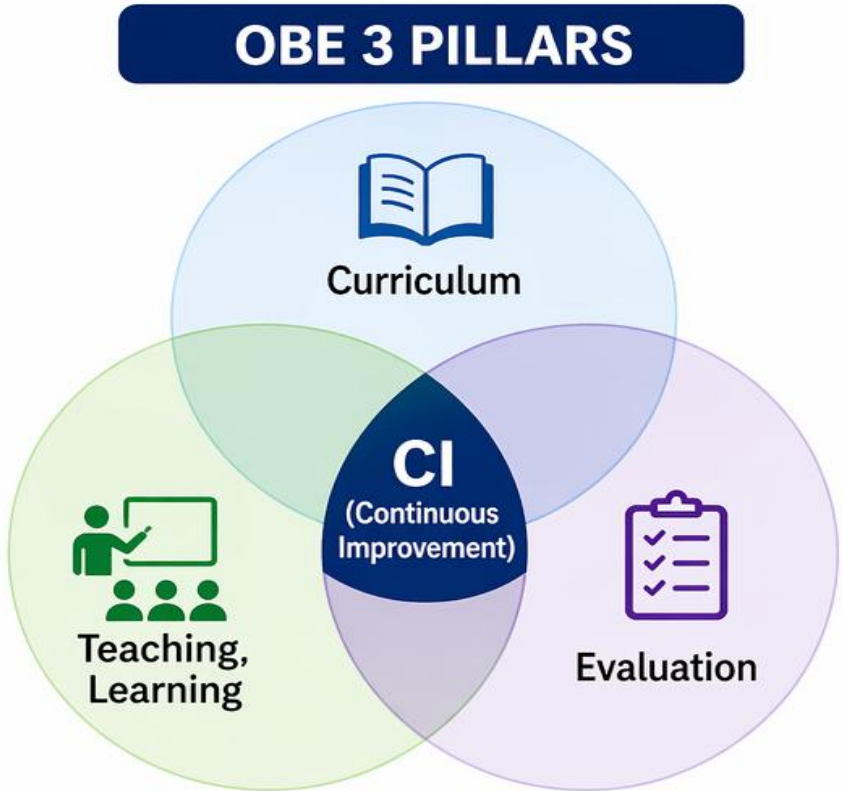
- Curriculum Design
- Appropriate Learning and Teaching
- Appropriate assessment and Evaluation Methods

02 COURSE OUTLINE DESCRIPTION (COD)

- Course Articulation

03 TERM WORK AND EVALUATION PROCESS

- Rubrics Framing and Evaluation



KEY TAKEAWAY

The key components of **Outcomes-Based Education (OBE)**, highlighting its philosophy through **effective curriculum design**, appropriate **teaching–learning strategies**, suitable **assessment methods**, **structured evaluation using rubrics** , and clear **course outline descriptions**.

ADVANTAGES OF OUTCOMES-BASED EDUCATION

OUTCOME-BASED EDUCATION-FRAMEWORK

1. OUTCOME HIERARCHY

2. TEACHING–LEARNING PROCESS

- Collaborative Learning
- Pedagogical Initiatives
- Experiential Learning
- Project-Based Learning
- Research-Based Learning
- Digital Initiatives

3. ASSESSMENT METHODS

Internal Assessment	• Continuous Internal Assessment • Lab Assessment • Project / Review Marks
External Assessment	• Semester End Examination
Feedback Mechanism	• Course End Survey • Program Exit Survey • Alumni & Employer Survey

4. CONTINUOUS IMPROVEMENT

Quality of Learning | Quality of Teaching | Learning Outcomes | Monitoring & Action Plan

Drives Continuous Improvement

> *“It’s not what we teach, it’s what they learn.”*

OUTCOME BASED EDUCATION- STUDENT CENTRIC INSTRUCTION MODEL

KNOWLEDGE
What students know

SKILLS
What students can do

ATTITUDES
How students behave and value

STUDENT-CENTRIC INSTRUCTION MODEL

OBE places students at the centre of education by aligning objectives, outcomes, teaching–learning strategies and assessment for continuous improvement and real-world readiness.

- Students at the Centre
- Outcome Focused
- Continuous Improvement
- Engaged Stakeholders
- Quality & Excellence

LEARNING DOMAINS

Learning occurs in three major domains that together contribute to holistic development.

1. COGNITIVE DOMAIN

Involves knowledge and the development of intellectual skills.

LEVELS (Bloom's Taxonomy – Revised)

Remember	Recall facts and basic concepts.
Understand	Explain ideas or concepts.
Apply	Use information in new situations.
Analyze	Break information into parts and explore relationships.
Evaluate	Justify a decision or course of action.
Create	Produce new or original work.

Examples

- Solving a math problem
- Analyzing a case study
- Designing an experiment
- Creating a project

2. AFFECTIVE DOMAIN

Involves attitudes, feelings, emotions, and values.

LEVELS (Krathwohl's Taxonomy)

Receiving	Being willing to listen and attend.
Responding	Actively participating or responding.
Valuing	Showing interest and attaching value.
Organizing	Integrating values and resolving conflicts.
Characterizing	Incorporating values into one's lifestyle.

Examples

- Showing respect
- Participating in class
- Demonstrating responsibility
- Developing ethical values

3. PSYCHOMOTOR DOMAIN

Involves physical movement, coordination, and the use of the motor-skill areas.

LEVELS (Simpson's Taxonomy)

Perception	Using sensory cues to guide motor activity.
Set	Being ready to act.
Guided Response	Imitating and practicing skills.
Mechanism	Performing skills with confidence and proficiency.
Complex Overt Response	Performing complex skills fluently and automatically.

Examples

- Writing neatly
- Using laboratory equipment
- Playing an instrument
- Performing a surgical procedure

Why All Three?

Developing cognitive, affective, and psychomotor domains ensures learners gain knowledge, build positive attitudes, and develop practical skills for real-life success.

COGNITIVE
Think
Knowledge & Intellectual Skills

+

AFFECTIVE
Feel
Attitudes & Values

+

PSYCHOMOTOR
Do
Skills & Physical Abilities

OBE OUTCOMES AND PROFILES

The list of outcome-based education outcomes and profiles are as follows:

01 **Program Educational Objectives (PEO):** Established with support of stakeholders

02 **Program Outcomes (PO):** By NBA (Eleven as per SAR 2025)

03 **Program Specific Outcomes (PSO):** Established with support of stakeholders

04 **Learning Domains (LD)**

05 **Knowledge and Attitude Profiles (WK):** Given NBA

06 **Engineering Competencies (EC)** - Range of Complex Engineering Problems (CP) and Complex Engineering Activities (CA)

07 **Sustainable Development Goals (SDGs)**

OUTCOME BASED EDUCATION – FOUR LEVELS

Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students, Parents, Industry Personnel and Recruiters. OBE is all about **feedback** and **outcomes.**

FOUR LEVELS OF OUTCOMES FROM OBE

1 PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Broad statements describing what graduates are expected to attain in their career and life.

2 PROGRAM OUTCOMES (POs)

Statements describing what students are expected to know and be able to do by the time of graduation.

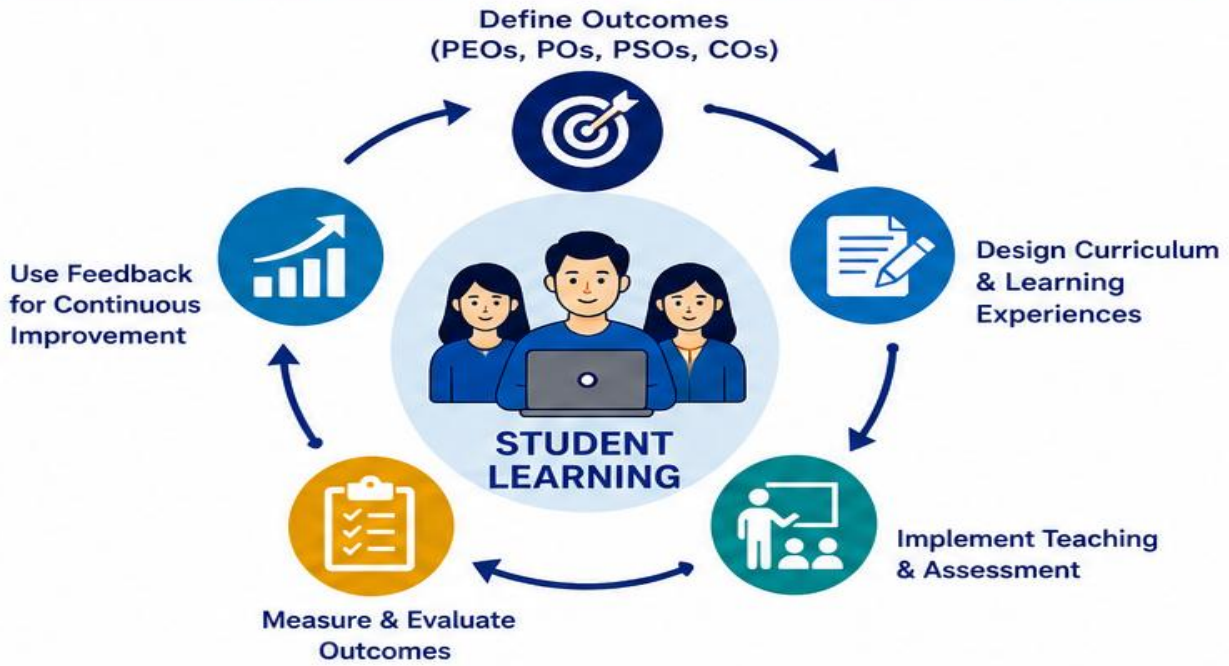
3 PROGRAM SPECIFIC OUTCOMES (PSOs)

Statements describing the specific skills and competencies students should develop.

4 COURSE OUTCOMES (COs)

Statements describing what students are expected to know and be able to do at the end of a course.

THE OBE PROCESS – A CONTINUOUS CYCLE



BENEFITS OF OBE

- Student-Centered Learning
- Improved Learning Outcomes
- Industry Relevant Graduates
- Continuous Improvement
- Stakeholder Satisfaction

STAKEHOLDERS BENEFITED

- Students
- Parents
- Industry Personnel
- Recruiters
- Institutions

OBE SHAPES COMPETENT ENGINEERS FOR A BETTER TOMORROW

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Our Commitment to Excellence in Engineering Education

I

PROGRAM EDUCATIONAL OBJECTIVE – I:

PREPARATION & LEARNING ENVIRONMENT

To prepare and provide student with an academic environment for students to excel in higher studies or to succeed in industry / technical profession and the life-long learning needed for a successful professional.

II

PROGRAM EDUCATIONAL OBJECTIVE – II:

CORE COMPETENCE

To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.

III

PROGRAM EDUCATIONAL OBJECTIVE – III:

BREADTH

To train students with good scientific and engineering breadth so as to comprehend, analyze, de- sign, and create novel products and solutions for the real-life problems.

IV

PROGRAM EDUCATIONAL OBJECTIVE – IV:

PROFESSIONALISM

To inculcate in students professional and ethical attitude, effective communication skills, team- work skills, multidisciplllinary approach, and an ability to relate engineering issues to broader social context.

Together, these objectives shape competent, ethical and innovative engineers who contribute to society and advance technology for a better tomorrow.

PROGRAM OUTCOMES (POs)

01 A Program Learning Outcome is **broad in scope** and be able to do at the end of the program.

02 POs are to be in line with the **graduate attributes** as specified in the **Washington Accord**.

03 Program outcomes are the **statements of what a student is expected** to know, understand and/or be able to demonstrate after completion of a process of learning.

04 These POs mainly relate to the **knowledge, skills and attitudes** that students acquire while progressing through the program.

05 POs are to be **specific**, **measurable** and **achievable**.

06 NBA has defined **11 POs**.

PROGRAM OUTCOMES (POs)

PO NUMBER	CATEGORY	DESCRIPTION
PO1	Engineering Knowledge	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in **WK1 to WK4** respectively to develop the solution of complex engineering problems.
PO2	Problem Analysis	Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. **(WK1 to WK4).**
PO3	Design / Development of Solutions	Design creative solutions for complex engineering problems and design / develop systems / components/ processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. **(WK5)**
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. **(WK8)**
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. **(WK2 and WK6).**
PO6	The Engineer and the World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. **(WK1, WK5, and WK7)**
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. **(WK9)**
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams. **(WK9)**
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. **(WK8)**

PROGRAM SPECIFIC OUTCOMES (PSOs)

Program specific outcomes (PSOs) include **subject-specific skills** and **generic skills**, including **transferable global skills** and **competencies**, the achievement of which the students of a specific program of study should be able to demonstrate for the award of the degree.
Program Specific Outcomes for each program, they are permitted up to **3 (three).**

WHAT ARE PSOs?

PSOs are the specific skills and competencies that students are expected to demonstrate at the time of graduation.

PROGRAM FOCUSED

PSOs are unique to each program and reflect its vision, mission, and the needs of stakeholders and industry.

MEASURABLE OUTCOMES

They are measurable, observable, and aligned with the curriculum and learning experiences.

LIMIT

Each program is permitted to define up to

3 (THREE) PSOs.

WRITING/ FRAMING COURSE OUTCOMES

01 The CO statements are defined by considering the **course content** covered in each module of a course.

02 Focus on the **learning that results** from the course rather than describing activities or lessons that are in the course.

03 Create statements that have a **student focus** rather than an instructor centric approach.

04 For every course there may be **5 or 6 Course Outcomes**.

05 The keywords used to define CO are based on **Bloom's Taxonomy**.

06 It also helps the faculty in designing **suitable delivery and assessment methods** to achieve the designed Course Outcomes.

DEVELOPMENT OF COURSE OUTCOME

CHARACTERISTICS OF EFFECTIVE COURSE OUTCOMES

01 | CLARITY
Describe what you want your students to learn in your course.

02 | ALIGNMENT
Are aligned with program goals and objectives.

03 | MEASURABILITY
Tell how you will know an instructional goal has been achieved.

04 | ACTION-ORIENTED
Use action words that specify definite, observable behaviours.

05 | ASSESSABILITY
Are assessable through one or more indicators (papers, quizzes, projects, presentations, journals, portfolios, etc.)

06 | REALISTIC
Are realistic and achievable.

07 | SIMPLICITY
Use simple language.

COURSE OUTCOMES FORMULA

STUDENTS SHOULD BE ABLE TO

ACTION VERB + BEHAVIOR + RESULTING EVIDENCE

SAMPLE COURSE OUTCOMES

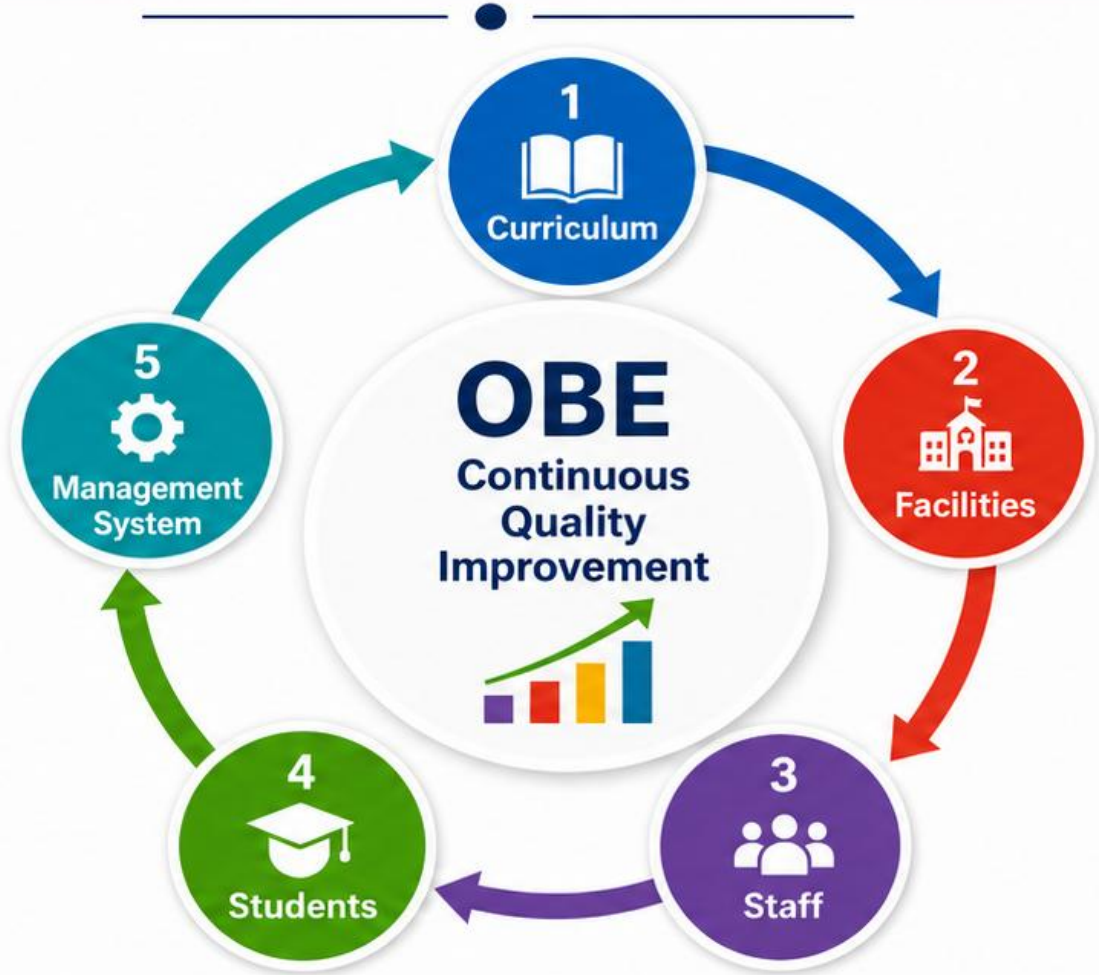
After successfully completing this course, the student will be able to:

Outcome Number	Course Outcomes	Learning Domain
CO1	Outline common data structures and fundamental algorithms, and familiarise with the associated terminology.	Understand
CO2	Illustrate Abstract Data Types (ADT) in terms of their data structures (strings, stacks, queues, linked lists, hash tables, trees and graphs).	Understand
CO3	Develop programs to implement common algorithms for sorting and searching data.	Apply
CO4	Compare common algorithms for sorting and searching data.	Analyse
CO5	Apply collision resolution techniques to resolve collisions within the hash table.	Apply
CO6	Choose the appropriate data structure to solve real-world problems and to defend the selection.	Apply

OBE–CONTINUES QUALITY IMPROVEMENT OF THE PROGRAMME

QUALITY IMPROVEMENT DEPENDS ON

1. Curriculum
2. Facilities
3. Staff
4. Students
5. Management System



QUALITY IMPROVEMENT

AI EXPERIENCE CENTER
Hands-on learning, innovation labs and real-world AI projects

AI EDUCATIONAL TECHNOLOGIES & TOOLS
Adaptive learning, intelligent assessments, analytics for personalized learning

UPCOMING EMPLOYMENT OPPORTUNITIES
Industry-aligned skills, AI competencies and career readiness programs

CURRICULUM UPGRADATION
Regular updates with AI & emerging technologies to meet industry demands

Enhanced Student Learning & Attainment of Program Outcomes

Continuous quality improvement is a cyclical process that ensures better learning outcomes and excellence in education.

OBE IMPLEMENTATION

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

01 Define Vision statements, Mission statements for the Institute and department

02 Define Program Educational Objectives (PEOs)

03 Program Outcomes and Program Specific Outcomes Statements (PSOs)

04 Role of Knowledge and Attitude Profiles (WKs)

05 Engineering Competencies (EC): Role of Engineering competencies for complex engineering problems solving and complex engineering activities

06 Define Course Outcomes

07 Map courses with PO/PSO

08 Define Course Outcomes with Bloom's Taxonomy for each course

09 Map topics with Course Outcomes

10 Prepare lecture-wise Course Lesson Plan – Schedule of instruction

11 Define pedagogical tools for course outcomes delivery

12 Implement, Monitor, Assess and Continuously Improve

COGNITIVE DOMAIN / BLOOM'S TAXONOMY LEVELS

LOWER ORDER THINKING SKILLS

Based on Bloom's taxonomy of critical thinking, Lower Order Thinking Skills have three levels. They are **Remember, Understand** and **Apply.**

HIGHER-ORDER THINKING SKILLS

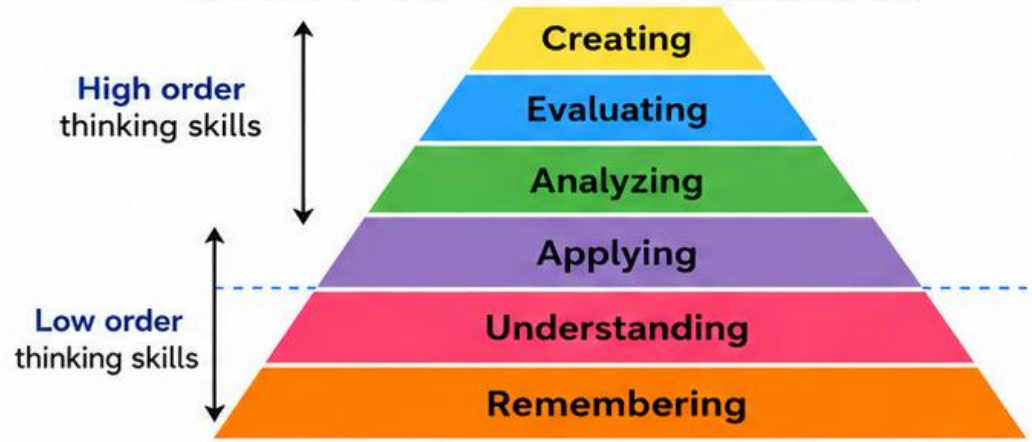
The higher-order thinking skills include **Analyze, Evaluate** and **Create.**

Higher-order thinking skills enable students to retain information learned, and apply problem-solving solutions to real world problems.

BLOOM'S REVISED TAXONOMY LEVELS

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

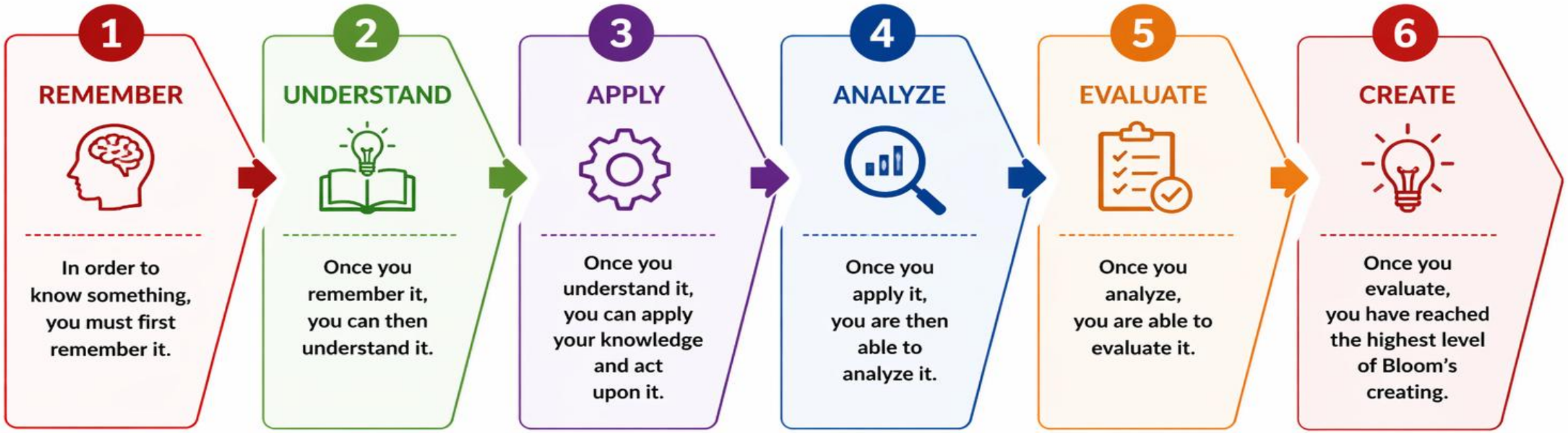
THINKING SKILLS HIERARCHY



Bloom's Taxonomy helps in designing effective learning experiences by matching learning outcomes with the appropriate level of thinking required from students.

PROGRESSION OF LEARNING

Guiding the progression of learning
from remembering and understanding to analyzing, evaluating, and creating.



ACTION VERBS

	I. REMEMBER	II. UNDERSTAND	III. APPLY	IV. ANALYZE	V. EVALUATE	VI. CREATE
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques, and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Contrast • Conclusion • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

AFFECTIVE DOMAINS (ALD) – BLOOM'S TAXONOMY

Affective domain (feelings, emotions and behaviour, i.e., attitude, or 'feel')

ALD LEVEL	CATEGORY	DESCRIPTION
ALD1	Receiving	This refers to the learner's sensitivity to the existence of stimuli – awareness, willingness to receive, or selected attention.
	Responding	This refers to the learners' active attention to stimuli and his/her motivation to learn – acquiescence, willing responses, or feelings of satisfaction.
ALD2	Valuing	This refers to the learner's beliefs and attitudes of worth – acceptance, preference, or commitment. An acceptance, preference, or commitment to value.
	Organization	This refers to the learner's internalization of values and beliefs involving (1) the conceptualization of values; and (2) the organization of a value system. As values or beliefs become internalized, the leaner organizes them according to priority.
ALD3	Characterization	This refers to the learner's highest of internalization and relates to behaviour that reflects (1) a generalized set of values; and (2) a characterization or a philosophy about life. At this level, the learner is capable of practising and acting on their values or beliefs.

PSYCHOMOTOR DOMAINS (PLD) – BLOOM'S TAXONOMY

Psychomotor domain (manual and physical skills, i.e., skills, or 'do'):
Ex: in areas of laboratory science subjects, engineering and physical education (Sports).

LEVELS OF PSYCHOMOTOR DOMAIN

LEVEL	CATEGORY	DESCRIPTION
PLD1	Perception set	The ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.
PLD2	Guided Response	The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.
	Mechanism	This is the intermediate stage in learning a complex skill. Learned responses are habitual and performed with confidence and proficiency.
PLD3	Complex / Overt Response	The skillful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, requiring a minimum of energy.
	Adaptation	Skills are well developed and fit special requirements.
	Origination	Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based on highly developed skills.

KNOWLEDGE AND ATTITUDE PROFILE (WK)

The list of **WKs** defines indicated volume of learning and attributes against which graduates must be able to perform. The list is used to extend and **clarify the definition of the Program Outcomes**.

In order to inculcate different dimensions of thinking mathematical, computational, design and creativeness among students in **cognitive, affective and psychomotor domains**.

The curriculum is designed to cover the following **nine knowledge and attitude profiles**. These profiles reflect an indicated volume of learning and the work attitude against which graduates must be able to perform.

Competency = [Knowledge + Skills + Dispositions] in Task.

Outcome-Based Engineering Education: PO–WK–Bloom's Integration

WKs: Knowledge and Attitude Profile

Applying Engineering Knowledge

Knowledge: WK1

Cognitive: Bloom's Taxonomy

- Tool Usage
- Individual and Collaborative Work Communication
- Project Management and Finance

WK2, WK6

Psychomotor: Dave's Taxonomy

Attitude, Engineer and the World, Ethics, Values, Culture and Life-long learning

WK5, WK7, WK9

BLOOM'S level

- Problem Analysis
- Design and Development
- Investigation

HIGHER level

- Evaluate
- Synthesize
- Create

WK2, WK3, WK4, WK8

Affective: Bloom's Taxonomy

KNOWLEDGE AND ATTITUDE PROFILE (WK)

Knowledge Profile (WK)

Importance of the knowledge in defining the essential knowledge areas required for achieving engineering graduate attributes.

WK1
natural sciences

WK2
mathematics, numerical analysis, statistics, computer and information science

WK3
engineering fundamentals

WK4
engineering specialist knowledge

WK5
engineering design

WK6
engineering practice

WK7
engineering in society

WK8
research literature

WK9
Knowledge of Ethics, Inclusion, and Conduct

COLOR SIGNIFICANCE

- **Orange** — Foundation Knowledge (Basic sciences, mathematics & core engineering knowledge)
- **Green** — Application Knowledge (Design, practice & societal application of engineering)
- **Blue** — Ethics and Professional Values (Ethics, inclusion and conduct in engineering practice)
- **Purple** — Knowledge Expansion (Research, investigation and advancement of knowledge)
- **Navy Blue** — Core / Central Theme (Central concept linking all knowledge areas together)

KNOWLEDGE AND ATTITUDE PROFILE (WK) AND INDICATORS OF ATTAINMENT

WK	KNOWLEDGE AND ATTITUDE PROFILE	WHAT IT ENCOMPASSES
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.	• Concepts of natural sciences (physics, chemistry, etc.) and relevant social sciences applied to solve discipline-specific problems.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	• Algorithms and numerical methods • Modelling of systems • Data analysis & visualization • Statistical techniques • Computational tools, simulation & modelling • Problem formulation, constraints • Use of IT tools for effective analysis.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	• Literature review • Problem identification • Model formulation & data collection • Validation of assumptions.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	• Domain knowledge for evaluation & validation • Standards, innovation & critical analysis • Engineering management principles • Economic decision-making.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.	• Sustainable design • Resource efficiency & re-use • Environmental impact & compliance • Net-zero carbon strategies • Feasibility (technical, sustainability, economic, ethical, safety, societal, environmental, cultural) • Communication of solutions with constraints & impacts.
WK6	Knowledge of engineering practice (Technology) in the practice areas in the engineering discipline.	• Selection of tools/resources • Simulation & modelling • Validation & evaluation of results • Integration of measurement systems with engineering design.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.	• Risk identification & management • Public health & safety assurance • Environmental protection & community concerns • Sustainable design, life-cycle analysis • Regulatory compliance & professional responsibility.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.	• Research literature review • Research design & data collection • Data analysis & interpretation • Critical thinking & emerging issues • Ethical research practices • Awareness of quality, standards & industry codes.
WK9	Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.	• Ethical awareness & conduct • Integrity, accountability & transparency • Inclusivity, diversity & respect in practice • Legal responsibilities • Responsible use of technology and resources.

KNOWLEDGE PROFILES (WK) & INDICATORS OF ATTAINMENT

WK1 — 01
Application of Natural Sciences

- Applying concepts of natural sciences viz., physics, chemistry, social science, and discipline specialized engineering science fundamentals for solving respective problems / applications.

WK2 — 08
Analytical Skills – Numerical Analysis, Data Analysis, Statistics, Modelling & Modern Engineering and IT Tools

- Algorithms & numerical methods for engineering problems
- Modeling real systems (analytical, numerical, empirical)
- Data analysis, statistics, visualization & interpretation
- Problem formulation, constraints & requirements
- Models (mathematical / physical) for prediction & analysis
- Computer systems for data storage & manipulation
- Use of computational tools, simulation & modelling
- Techniques with data visualization for effective analysis

WK3 — 03
Theory-Based Formulation

- Gathers engineering knowledge from the open literature
- Theoretical problem identification, model formulation & data collection
- Evaluates analysis for accuracy & validity of assumptions

WK4 — 03
Engineering Specialist Knowledge

- Apply engineering specialist knowledge for evaluation & validation of assumptions
- Understanding of standards, innovation & critical analysis for accepted practices
- Apply engineering management principles to effectively implement economic decision-making

WK5 — 06
Knowledge of Resource Use, Environmental Impacts, Net-zero Carbon Support Engineering Design, Operations & Constraints and Boundaries

- Sustainable design & social value incorporation
- Modern modelling & computational tools for design & optimization
- Feasibility evaluation (technical, sustainability, economic, ethical, health & safety, societal, environmental, cultural)
- Net-zero strategies, energy efficiency & low-carbon technologies
- Waste minimization, resource reuse & regulatory compliance
- Communication of solutions with constraints & impacts

WK6 — 03
Knowledge of Engineering Practice (Technology) in the Practice Areas

- Identify, select & justify tools/resources considering limitations
- Simulate behaviour/model outcomes, validate & evaluate results
- Integration of measurement systems for process parameters with engineering design

WK7 — 04
Knowledge of the Role of Engineering in Society, Issues in Engineering Practice & Professional Responsibility to Public Safety and Sustainable Development

- Risk identification & management strategies
- Public health, safety, hazards & system assurance
- Environmental protection & community concerns
- Sustainable design, life-cycle analysis & compliance with regulations

WK8 — 07
Engagement with Selected Knowledge in the Current Research Literature of the Discipline, Awareness of the Power of Critical Thinking, Creative Approaches to Evaluate Emerging Issues

- Literature review & identification of research needs
- Research design, experimentation & data collection
- Data analysis, interpretation & evaluation
- Critical thinking, creative solutions & emerging issues
- Ethical research practices & dissemination of findings
- Awareness of quality, standards & industry codes

WK9 — 04
Knowledge of Ethics, Inclusion and Conduct

- Ethical awareness & professional conduct
- Uphold integrity, accountability & transparency
- Inclusivity, diversity & respect in professional practice
- Awareness of legal responsibilities & compliance in engineering practice

These WKs collectively define the essential knowledge, skills, and attitudes required to achieve graduate attributes and address complex engineering problems in a responsible and sustainable manner.

INDICATORS OF ATTAINMENT

PO Number	POS Mapped to WKS	Number of IAs
PO1	WK1 to WK4	15
PO2	WK1 to WK4	15
PO3	WK5	06
PO4	WK8	07
PO5	WK2 and WK6	11
PO6	WK1, WK5, and WK7	11
PO7	WK9	06
PO8	WK 9	06
PO9	WK-1 & WK-9	07
PO10		16
PO11	WK8	13

PSO Number	Indicators of attainment (IA)	Number of IAs
PSO 1	WK 1a, WK 2a, WK 2c, WK 2d, WK 2f, WK 2h, WK 3a, WK 3b, WK 3c, WK 4a, WK 4b	11
PSO 2	WK 2c, WK 2d, WK 2g, WK 2h, WK 3a, WK 3c, WK 4a, WK 6a	08
PSO 3	WK 7a, WK 7b, WK 7c, WK 8b, WK 8e, WK 8f, WK 9a, WK 9b, WK 9c, WK 9f	10

ENGINEERING COMPETENCE (EC) PROFILES

integrating knowledge, skills, and dispositions to develop engineering competence and bridge skill gaps in education.

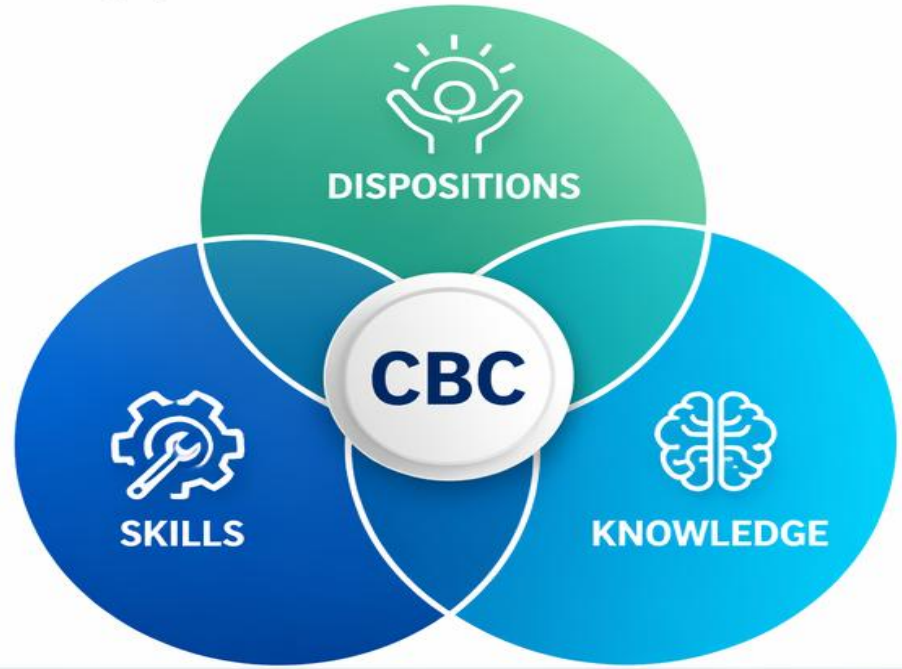
PROCESS

Competency is an Integration of

Knowledge
(what one knows)

Skills
(what one can do)

Dispositions
(attitudes and behaviours)



SKILL GAPS

Bridging the Gap

Strategic Skill Mapping
Align curriculum and competencies with industry needs.

Bridging the Gap
Identify gaps and implement targeted interventions.

Future-Proofing Education
Equip learners with future-ready skills and mindsets.

Integrating Knowledge, Skills, and Dispositions to Build Competent, Ethical, and Future-Ready Engineers.

ENGINEERING COMPETENCE (EC) PROFILES

integrating knowledge, skills, and dispositions to develop engineering competence and bridge skill gaps in education.

The pedagogy for imparting competencies should include:

01	**ACTIVE LEARNING**	Students should be engaged in activities that require them to apply knowledge to solve problems, make decisions, and achieve goals. This includes hands-on activities, case studies, simulations, and group projects.
02	**COLLABORATIVE LEARNING**	Collaboration is an essential part of engineering practice. Therefore, students should be encouraged to work in teams to solve problems and deliver solutions. This can be achieved through group projects, peer-to-peer learning, and teamwork exercises.
03	**CONTEXTUAL LEARNING**	Learning should be contextualized to real-world problems and challenges. This can be achieved through project-based learning, case studies, and simulations.
04	**FEEDBACK AND REFLECTION**	Students should receive timely and constructive feedback on their work, and encouraged to reflect on their learning experiences to identify areas for improvement.
05	**EXPERIENTIAL LEARNING**	Students should be provided with opportunities to gain real-world experience through internships, co-op programs, and other experiential learning opportunities.

Engineering education should be designed to impart competencies that enable graduates to **apply their knowledge to solve real-world problems effectively**. This requires a pedagogy that emphasizes **active learning, collaborative learning, contextual learning, feedback and reflection,** and **experiential learning**.

ENGINEERING COMPETENCE (EC) PROFILES

Differences between technical problems and complex engineering problems

ASPECT	TECHNICAL PROBLEMS	COMPLEX ENGINEERING PROBLEMS
Solution Approach	Solutions are often straightforward and based on standard practices.	Solutions involve iteration, optimization, and may need novel approaches.
No. of solutions	Limited set of alternative solutions.	No bounded set of alternative solutions.
Uncertainty	Low uncertainty; variables are usually known and controlled.	High uncertainty; may involve unknown variables and unpredictable factors.
Example	Single optimal and testing solutions and clearly recognized.	No single optimal and/or objectively testable solutions.
Collaboration Needed	Usually, can be solved by an individual or small team.	Requires collaboration among large, diverse teams and stakeholders.

Complex engineering problems are characterized by **uncertainty, interdependencies, and multiple perspectives,** requiring **innovative thinking, iterative solutions, and collaborative approaches.**

Complex Engineering problems

Complex engineering problems are difficult to define, analyze, and solve because they involve multiple factors, uncertainties, and constraints.

The **engineering competence (EC)** profiles - **complex engineering problems (CP)** and **complex engineering activities (CA)** record the elements of competence necessary for performance that the professional is expected to be able to demonstrate in a holistic way the stage of attaining registration.

Complex Engineering Problems have characteristic **WK1** and some or all **WK2 to WK9** as defined by National Board of Accreditation (NBA).

Also, there are a Range of **Complex Engineering Activities (CA)** involved in when solving complex engineering problems.

COMPLEX PROBLEM

Need to think broadly and systematically and **see the big picture**

Difficult	Decision
Uncertain	Strategy
Confusing	Idea
Contentious	Product
Intractable	Change

DIFFICULTY & UNCERTAINTY

COMPLEXITY – the problem contains a large number of diverse, dynamic and interdependent elements.

MEASUREMENT – it is difficult or practically unfeasible to get good qualitative data.

NOVELTY – there is a new solution evolving or an innovative design is needed.

FORMATION OF COMPLEX PROBLEMS

SCIENTIFIC / TECHNICAL PROBLEMS can combine to form → **A COMPLEX PROBLEM**

Understanding that multiple scientific and technical issues can combine to create complex engineering problems.

ENGINEERING COMPETENCE (EC) PROFILES

Engineering competence involves the ability to solve complex engineering problems and perform complex engineering activities tasks effectively.

1. COMPLEX SYSTEMS INVOLVE MULTIPLE INTERACTING FACTORS

Complex systems involve multiple interacting factors and are difficult to isolate and measure.

- **UNBOUNDED SYSTEMS**
  No experiment
- **COMPLEX CAUSAL CHAINS**
  Multiple interdependencies
- **DIFFICULT TO MEASURE**
  Many variables and uncertainties
- **OPERATING WITH SCARCE RESOURCES**
  Constraints and limitations

2. COMPLEX PROBLEMS ALLOW LIMITED PREDICTION, EXPLANATION, AND CONTROL

Complex problems allow limited prediction, explanation, and control.

- **LIMITED EXPLANATION, PREDICTION, CONTROL**
  Inexact information, assumptions
- **EXPLANATION, PREDICTION, CONTROL**
  To some extent possible
- **ISOLATABLE SYSTEMS**
  Controlled experiment
- **OPERATING WITH ADEQUATE RESOURCES**
  Availability of resources

3. MODELS & APPROXIMATIONS TO ANALYZE COMPLEX SYSTEMS

Engineers use models and approximations to analyze complex systems.

- **RESULTS IN AN EDUCATED GUEST**
  Best possible solution
- **RESULTS IN A GOVERNING LAW**
  Generalized relationships
- **FUNCTIONAL RELATIONSHIP**
  Mathematical model
- **A LIMITED NUMBER OF FEATURES ARE CAPTURED BY THE MODEL**
  Simplifications and assumptions

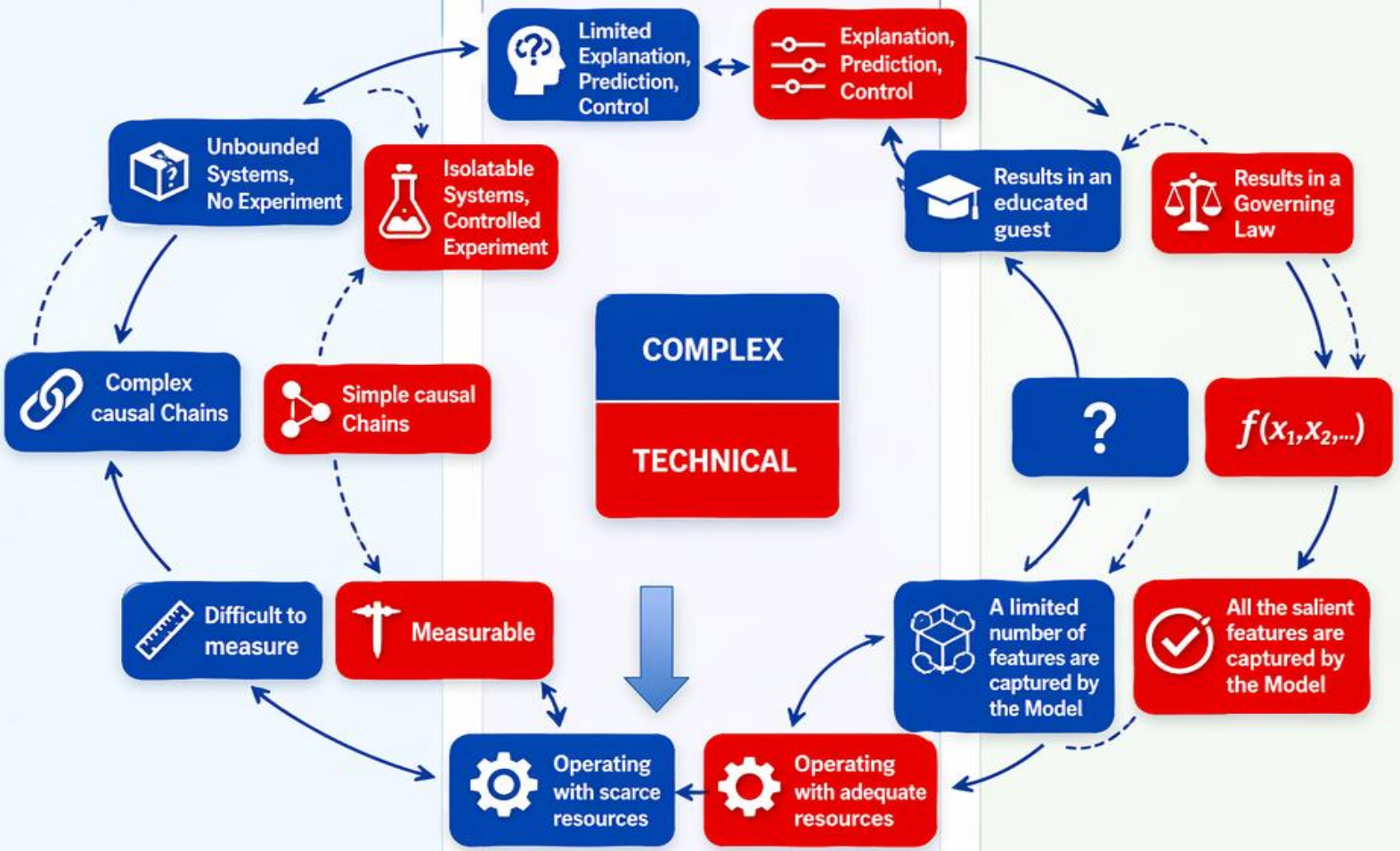
EC PROFILE	MEANING
COMPLEX SYSTEMS INVOLVE MULTIPLE INTERACTING FACTORS	Characteristics of complex engineering problems (uncertainty, limited prediction, difficult measurement).
COMPLEX PROBLEMS ALLOW LIMITED PREDICTION, EXPLANATION, AND CONTROL	Characteristics of complex problems where systems are measurable to some extent, predictable to some extent, and controllable to some extent.
MODELS & APPROXIMATIONS TO ANALYZE COMPLEX SYSTEMS	Characteristics of modeling and approximation used by engineers to analyze and solve complex problems.

ENGINEERING COMPETENCE (EC) PROFILES

LEFT SECTION
Complex systems involve multiple interacting factors and are difficult to isolate and measure.

MIDDLE SECTION
Complex problems allow limited prediction, explanation, and control.

RIGHT SECTION
Engineers use models and approximations to analyze complex systems.



Left Section: Complex systems involve **multiple interacting factors** and are **difficult to isolate and measure.**

Middle Section:
Complex problems allow **limited prediction, explanation,** and **control.**

Right Section:
Engineers use **models** and **approximations** to analyze complex systems.

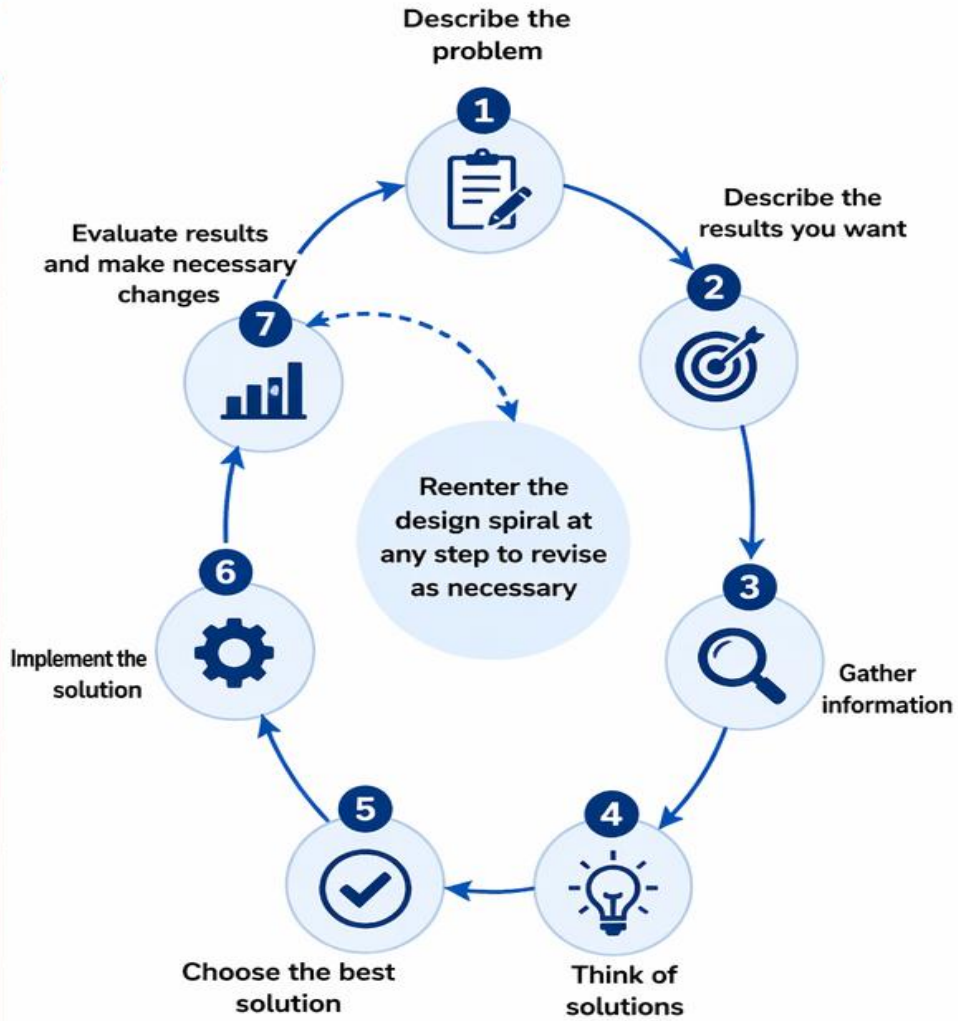
COLOR	MEANING
BLUE	Characteristics of complex engineering problems (uncertainty, limited prediction, difficult measurement).
RED	**Characteristics of simple/technical** problems where systems are measurable, predictable, and controllable.

Complex Engineering problems

Characteristics

Technical Problems	Complex Problems
Isolatable boundable problem	No definitive problem boundary
Universally similar type	Relatively unique or unprecedented
Stable and/or predictable problem parameters	Unstable and/or unpredictable problem parameters
Multiple low-risk experiments are possible	Multiple experiments are not possible
Limited set of alternative solutions	No bounded set of alternative solutions
Involve few or homogeneous stakeholders	Multiple stakeholders with different views or interest
Single optimal and testable solutions	No single optimal and/or objectively testable solution
Single optimal solution can be clearly recognized	No clear stopping point

The Technological Method of Problem Solving



COMPLEX ENGINEERING PROBLEMS – EXAMPLES

01 

Designing a more efficient solar panel system to maximize energy production.

02 

Developing a new bridge design to withstand extreme weather conditions.

03 

Optimizing the fuel efficiency of a car engine.

04 

Creating a filtration system to clean contaminated water.

05 

Designing a robotic arm with increased precision for a manufacturing process.

ENGINEERING COMPETENCE (EC) PROFILES

EC	Attributes	Descriptors for Rubric Design
EC 1	Depth of knowledge required (CP)	Ensures that all aspects of an engineering activity are soundly based on fundamental principles - by diagnosing, and taking appropriate action with data, calculations, results, proposals, processes, practices, and documented information that may be ill-founded, illogical, erroneous, unreliable or unrealistic requirements applicable to the engineering discipline.
EC 2	Depth of analysis required (CP)	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.
EC 3	Design and development of solutions (CA)	Support sustainable development solutions by ensuring functional requirements, minimize environmental impact and optimize resource utilization throughout the life cycle, while balancing performance and cost effectiveness.
EC 4	Range of conflicting requirements - (CP)	Competently addresses complex engineering problems which involve uncertainty, ambiguity, imprecise information and wide-ranging or conflicting technical, engineering and other issues.
EC 5	Infrequently encountered issues (CP)	Conceptualises alternative engineering approaches and evaluates potential outcomes against appropriate criteria to justify an optimal solution choice.
EC 6	Protection of society (CA)	Identifies, quantifies, mitigates and manages technical, health, environmental, safety, economic and other contextual risks associated to seek achievable sustainable outcomes with engineering application in the designated engineering discipline.
EC 7	Range of resources (CA)	Involve the coordination of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies) in the timely delivery of outcomes.
EC 8	Extent of stakeholder involvement - (CP)	Design and develop solution to complex engineering problem considering a very perspective and taking account of stakeholder views with widely varying needs.
EC 9	Extent of applicable Codes, Legal and Regulatory- (CP)	Meet all level, legal, regulatory, relevant standards and codes of practice, protect public health and safety in the course of all engineering activities.
EC 10	Interdependence - (CP)	High level problems including many component parts or sub-problems, partitions problems, processes or systems into manageable elements for the purposes of analysis, modelling or design and then re-combines to form a whole, with the integrity and performance of the overall system as the top consideration.
EC 11	CPD	Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.
EC 12	Judgement - (CA)	Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Require judgement in decision making in the course of all complex engineering activities.

Note: CPD – Continuing Professional Development (CPD) and lifelong learning (CA)

ENGINEERING COMPETENCE (EC) PROFILES

1. DEPTH OF KNOWLEDGE REQUIRED

- Includes mastering **core principles**, **theories**, and methodologies and **integrating interdisciplinary knowledge**.
- **For example**, an electrical engineering student working on renewable energy solutions must understand **photovoltaic systems**, **grid integration**, and **power electronics** to design efficient solar power systems.
- applying **machine learning** in predictive maintenance combines mechanical engineering knowledge with **AI**, demonstrating depth and interdisciplinary integration.

2. DEPTH OF ANALYSIS REQUIRED

- Complex engineering problems require **comprehensive analysis** to identify root causes and evaluate potential solutions systematically.
- **For example,** Encourage students to break problems into smaller components, using tools like **FEA software** or **simulation models.**
- analyzing the **aerodynamics** of a vehicle demands evaluating fluid dynamics, material strength, and environmental impacts through simulations like **CFD.**

3. DESIGN AND DEVELOPMENT OF SOLUTIONS

- Engineering solutions should meet **technical**, **environmental**, and **societal** needs, balancing functionality with **sustainability** and **ethics**.
- Students should apply systematic approaches such as **design thinking** or **V-models** (verification and validation) to create prototypes and test iterations.
- **For example**, a mechanical engineering student designing a prosthetic limb must balance **comfort**, **cost**, **durability**, and **adaptability** to different user needs.
- designing a solar-powered water pump involves optimizing **energy efficiency**, **cost-effectiveness**, and **durability** under different weather conditions.

4. RANGE OF CONFLICTING REQUIREMENTS

- Involve balancing conflicting demands like **cost**, **efficiency**, and **environmental sustainability**.
- Encourage students to prioritize requirements using **decision matrices** or **trade-off analyses**.
- **For example**, urban infrastructure projects, balancing **affordability** with **durability** and **community aesthetics** is critical.
- might require **iterative planning** and **stakeholder engagement**.

ENGINEERING COMPETENCE (EC) PROFILES

05 INFREQUENTLY ENCOUNTERED ISSUES

Students must prepare for rare and unpredictable problems by cultivating **adaptive problem-solving skills** (flexible, creative, and resilient).

FOR EXAMPLE

- Addressing unexpected vibrations in a suspension bridge requires innovative damping techniques and material adjustments.
- Extreme weather effects on renewable energy systems.

06 PROTECTION OF SOCIETY

Engineering designs must safeguard human lives and the environment, adhering to **ethical and safety standards**.

FOR EXAMPLE

- Students should incorporate safety features into designs, such as fail-safes in autonomous vehicles.
- Students must evaluate societal impacts, like reducing emissions in industrial projects, to ensure sustainability.

07 RANGE OF RESOURCES

Effective problem-solving involves leveraging **diverse resources**, from advanced tools to expert consultations.

FOR EXAMPLE

- Students should utilize simulation tools, such as MATLAB or ANSYS, and collaborate with industry professionals.
- In power grid optimization, leveraging IoT and big data ensures efficient resource utilization and predictive maintenance.

08 EXTENT OF STAKEHOLDER INVOLVEMENT

Stakeholders, including clients, communities, and governments, play a **pivotal role** in engineering projects.

FOR EXAMPLE

- Students should learn to engage stakeholders through **surveys, workshops**, and **public consultations**.
- Designing public transportation systems requires understanding commuter needs and regulatory frameworks.
- Designing a sustainable water supply system for a rural area requires understanding community needs, budget constraints, and regulatory requirements.

ENGINEERING COMPETENCE (EC) PROFILES

9 EXTENT OF APPLICABLE CODES, LEGAL AND REGULATORY

- Engineering solutions must comply with local, national, and international standards to ensure legality and functionality.
- Familiarity with codes such as **ISO, ASME, or IEEE** is essential.
- Students can explore case studies where non-compliance led to project failures, emphasiziing the importance of legal adherence in areas like construction or data security.

EXAMPLE:
An aerospace engineering student designing a drone must ensure compliance with aviation regulations and airspace restrictions.

10 INTERDEPENDENCE

- Engineering solutions often rely on the integration of multiple systems and disciplines.
- Students should study examples like smart cities, which integrate **IoT, renewable energy, and AI.**
- Projects should involve collaborative tasks where mechanical, electrical, and software engineering intersect, such as robotics.

EXAMPLE:
A smart traffic management system requires collaboration between software engineers, urban planners, and transportation experts.

COMPETENT ENGINEER

Knowledgeable
Collaborative
Ethical
Lifelong Learner

11 CONTINUING PROFESSIONAL DEVELOPMENT (CPD) AND LIFELONG LEARNING

- Engineers must embrace continuous learning to adapt to evolving technologies and industry practices.
- Students should be encouraged to attend **webinars, pursue certifications, and participate in hackathons.**

Webinars | Certifications | Hackathons

EXAMPLES:

Learning about additive manufacturing techniques (3D printing) can help mechanical engineers stay competitive.

Learning **blockchain** technology can enhance their capabilities in secure system design.

12 JUDGEMENT

- Engineering judgement is critical for making decisions under uncertainty, balancing technical knowledge with ethical considerations.
- Encouraging participation in competitions like the **Ethics Bowl** can enhance decision-making skills.

EXAMPLE:
An environmental engineering student deciding on waste disposal methods must weigh ecological impact against economic feasibiiity and community acceptance.

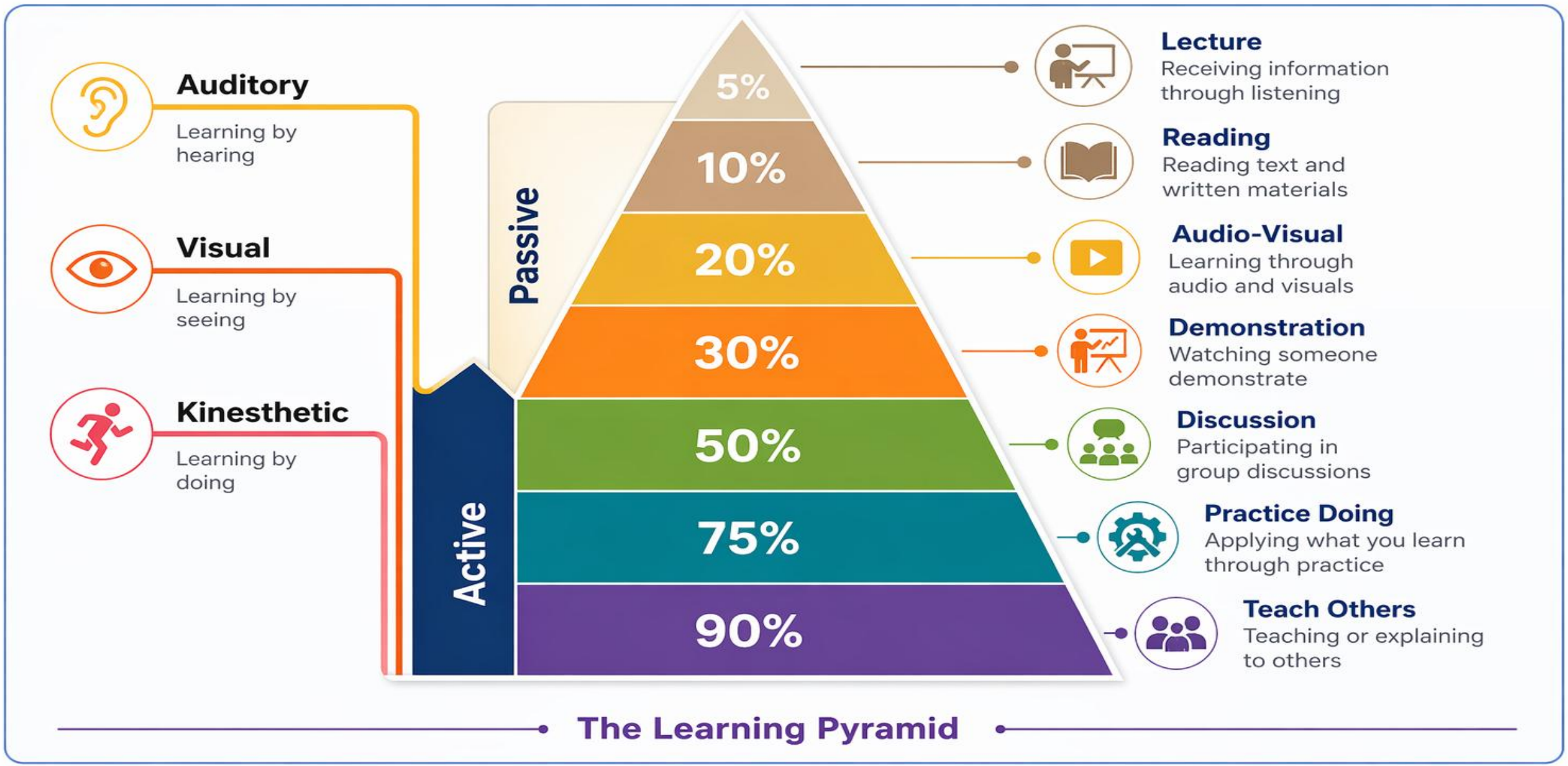
FACTORS TO CONSIDER

- Ecological Impact
- Economic Feasibility
- Community Acceptance

Ethical decisions lead to sustainable solutions.

Building a better future through compliance, collaboration, continuous learning, and ethical judgement.

ACTIVITIES ON TERM WORK (TW) AND SELF LEARNING (SL)



The Learning Pyramid

TERM WORK AND SELF LEARNING ACTIVITIES

- Practical learning and skill development are essential components of engineering and professional education. Term work and self-learning activities play a crucial role in bridging the gap between theoretical knowledge and real-world application.
- These activities help students acquire the necessary competencies to meet industry demands and address societal needs. By engaging in such tasks, students are able to develop technical, analytical, and soft skills, ensuring their readiness for professional challenges. This approach promotes holistic development, aligning with the goals of producing well-rounded and capable professionals.

TERM WORK

1. HOME ASSIGNMENTS

Home Assignments are structured learning activities designed to strengthen their understanding of core concepts beyond classroom teaching. These assignments promote self-learning, critical thinking, and the practical application of theoretical knowledge.

- Strengthens Understanding
- Promotes Self-Learning
- Encourages Critical Thinking
- Applies Knowledge

SELF-LEARNING

- Self-learning components in a curriculum are designed to encourage students to take initiative in their education by utilizing various resources and platforms.
- They empower students to take control of their learning, explore topics of interest in greater depth, and develop independent learning skills that are crucial in today's rapidly evolving educational landscape.

- Encourages Exploration
- Builds Independence
- Utilizes Diverse Resources
- Develops Future-Ready Skills

TOGETHER, THESE ACTIVITIES:

- Bridge Theory and Practice
- Develop Competencies for Industry
- Address Societal Needs
- Prepare Students for Professional Success

COMPONENTS OF TERM WORK AND SELF-LEARNING

S.No	COMPONENTS OF TERM WORK	COMPONENTS OF SELF-LEARNING
1	Home Assignments	MOOCs (Massive Open Online Courses)
2	Program Assignments	Online Educational Resources
3	Definition and Terminology	Tech Talk
4	Hack-a-thon	Interactive Learning Platforms
5	Work-based learning / Practical Training (Placement)	Professional Certifications
6	Seminars / Presentations / Seminar Preparation	Virtual Labs
7	Course Projects / Complex Problem Solving	Independent Private Study (PLNs)
8	Open-ended Problems	E-Books and Audiobooks
9	Technical Visits	Virtual Study Groups
10	Laboratory Exercises / Practical Work	Concept Video (Individual Presentations)
11	Design Exercises and Implementation	Poster Presentation
12	Workshops	Specific Research Activities
13	Group Projects	Group Presentation
14	Case Studies	IARE Study Space – Samvida
15	Quizzes	—
16	Field Work / Activities	—
17	Journals / Logbooks	—
18	Community Service / Outreach	—
19	Demonstration	—

ADOPTING UNITED NATION'S SUSTAINABLE DEVELOPMENT GOALS

A shared blueprint for peace, prosperity, people and the planet, now and in the future.

People: End poverty and hunger in all forms and ensure dignity and equality.

Planet: Protect our planet's natural resources and climate for future generations.

Prosperity: Ensure prosperous and fulfilling lives in harmony with nature.

Peace: Foster peaceful, just and inclusive societies.

Partnership: Implement the agenda through a global partnership.

SUSTAINABILITY

The 17 Sustainable Development Goals (SDGs) guide our actions towards a better future.

CORRELATION MATRIX OF POS – ECS – WKS – SDGS

POs	ECs	WKs	SDGs
PO1	EC 1	WK-1, WK-2, WK-3, WK-4	SDG-9
PO2	EC 4, 2,10	WK-1, WK-2, WK-3, WK-4	SDG - 1 to 17
PO3	EC 4, EC 5, EC 8,	WK-5	SDG - 1, 2, 3, 6, 10, 11, 12, 13, 14
PO4	EC 5, EC 7	WK-8	SDG - 9
PO5	EC 2, EC 5	WK-1, WK-5, WK 7	SDG - 9
PO6	EC 6, EC 9	WK-1, WK-5, WK 7	SDG - 1 to 17
PO7	EC 9	WK-9	SDG - 5, 10, 16
PO8	EC 8	WK 1,9	SDG - 5, 10, 16
PO9	EC 10,7,12	WK-2,5	SDG - 9
PO10	—	—	SDG - 9, 13
PO11	EC 11	WK-8	SDG - 9, 13

ASSESSMENT

ASSESSING TODAY, EMPOWERING TOMORROW.

OUTCOMES

Measure learning outcomes and achieve goals.

ASSESSMENT

Use effective assessments to inform progress.

TEACHING-LEARNING

Enhance instruction and support student learning.

CURRICULUM

Align curriculum with standards and real-world skills.

IMPROVEMENT

Drive continuous improvement for better results.

OUTCOME BASED METHODS FOR MEASURING LEARNING OUTCOMES

There are many different ways to assess student learning. In this section, we present the different types of assessment approaches available and the different frame works to interpret the results.

1. ASSESSMENT THROUGH EVALUATION

1 Continuous Internal Assessment (CIA)
Two internal examinations and other assessments conducted during the semester.

2 Alternate Assessment Tools (AAT)
Includes tutorials, assignments, seminars, projects, MOOCs, videos, METE, term papers, etc.

3 Semester End Examination (SEE)
End of semester examinations with course reviews and remedial measures for improvement.

2. EXPERIENTIAL LEARNING

4 Laboratory Work
Continuous assessment of lab work to match industry requirements.

Project Work
Student projects addressing research/industrial problems with periodic reviews.

3. FEEDBACK & SURVEYS

5 Course Exit Survey
Students provide feedback on course objectives and learning experience.

6 Program Exit Survey
Final year students share feedback on program objectives, experiences and suggestions.

7 Alumni Survey
Collects information on careers, higher studies, skills gained and engagement with the institution.

8 Employer Survey
Employers feedback on skills, competencies, gaps and training needs of graduates.

4. ACADEMIC COMMITTEES & GOVERNANCE

9 Course Expert Committee
Develops, reviews and renews course content and ensures quality and effectiveness.

10 Program Assessment and Quality Improvement Committee (PAQIC)
Monitors POs & PEOs, evaluates program effectiveness and recommends improvements.

11 Department Advisory Board (DAB)
Provides guidance, monitors progress and recommends curriculum & resource enhancements.

12 Faculty Meetings
Regular discussions on academic performance, feedback analysis and action planning.

5. PROFESSIONAL ENGAGEMENT

13 Professional Societies
Engagement with professional bodies such as IEEE, ISTE, IETE, IEI, etc. to promote knowledge sharing, research, innovation and lifelong learning.

IEEE · ISTE · IETE · IEI

CONTINUOUS QUALITY IMPROVEMENT CYCLE

ASSESS
Collect data using various assessment methods.

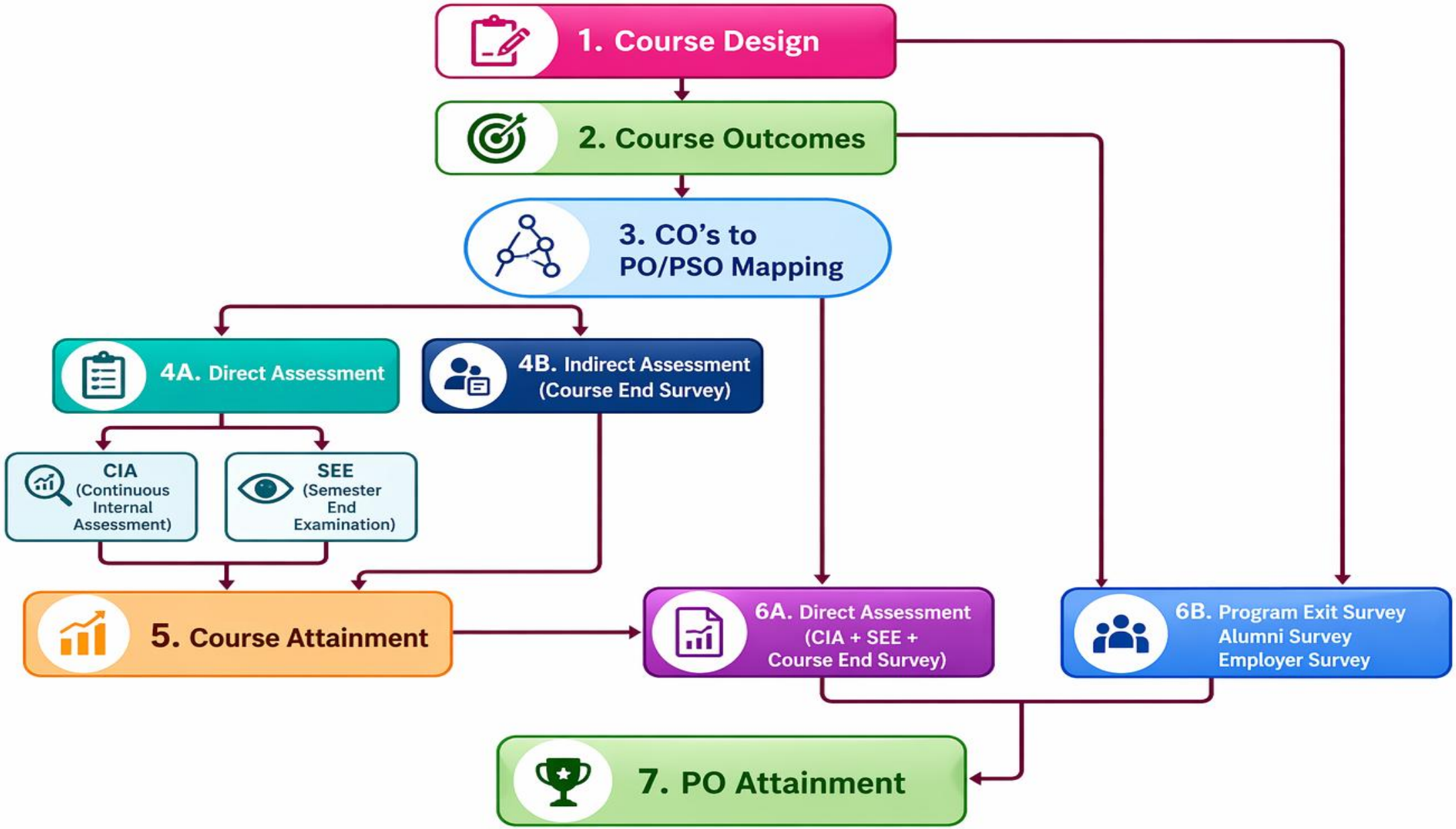
→ **ANALYZE**
Analyze and interpret data to identify gaps and opportunities.

→ **FEEDBACK**
Share feedback with stakeholders for informed decision making.

→ **IMPROVE**
Implement changes in curriculum, teaching and resources.

→ **REASSESS**
Reassess outcomes to ensure improvement and effectiveness.

CO/PO ATTAINMENT PROCESS



OUTCOME BASED ASSESSMENT PROCESSES

Course outcomes are evaluated based on two approaches namely **direct** and **indirect** assessment methods. The direct assessment methods are based on the Continuous Internal Assessment (CIA) and Semester End Examination (SEE) whereas the **indirect** assessment methods are based on the course end survey and program exit survey provided by the students, Alumni and Employer.

1 DIRECT ASSESSMENT

Direct assessment methods are based on the student's knowledge and performance in the various assessments and examinations. These assessment methods provide evidence that a student has command over a specific course, content, or skill, or that the students work demonstrates a specific quality such as creativity, analysis, or synthesis.

DIRECT ASSESSMENT TOOLS

- **Continuous Internal Examination (CIA)**
- **Semester End Examination (SEE)**
- **Alternate Assessment Tools (AAT)** (Includes assignment, 5 minutes videos, seminars etc.)

- Continuous internal examination, semester end examinations, AAT (includes assignment, 5 minutes videos, seminars etc.) are used for CO calculation.
- The attainment values are calculated for individual courses and are formulated and summed for assessing the POs.
- Performance in AAT is indicative of the student's communication skills.

EVALUATE ANALYZE IMPROVE

2 INDIRECT ASSESSMENT

Indirect assessment methods are based on feedback collected from stakeholders. These methods provide perceptions about the course, learning experience, its effectiveness and areas for improvement.

INDIRECT ASSESSMENT TOOLS

- **Course End Survey**
- **Program Exit Survey**
- **Alumni Survey**
- **Employer Survey**

Course End Survey

In this survey, questionnaires are prepared based on the level of understanding of the course and the questions are mapped to Course Outcomes.

STAKEHOLDERS INVOLVED

STUDENTS | ALUMNI | EMPLOYERS | FACULTY | INSTITUTE

OUTCOME BASED PO/PSO ATTAINMENT

The attainment of POs/PSOs are calculated through direct and indirect assessment methods.

- **Direct assessment** is calculated through Continuous Internal Assessment (CIA) and Semester End Exam (SEE).
- **Indirect assessment** is calculated through feedback from program exit survey, alumni and employers/industry.

DIRECT ASSESSMENT

(80%)

Direct assessment is based on students' performance in internal assessments and end semester examinations which provide evidence of learning achievement.

- **Continuous Internal Assessment (CIA) (40%)**
- **Semester End Examination (SEE) (60%)**

INDIRECT ASSESSMENT

(20%)

Indirect assessment is based on feedback collected from stakeholders which provides perceptions about the program, learning experience and areas for improvement.

- **Program Exit Survey (10%)**
- **Alumni Survey (5%)**
- **Employer Survey (5%)**

Purpose: To measure and improve program effectiveness by evaluating the attainment of **Program Outcomes (POs)** and **Program Specific Outcomes (PSOs)** using both direct and indirect assessments.

Course outcomes are mapped with PO/PSO

Course Outcome: Machine Learning Techniques

CO1 Explain the fundamental concepts of **Machine Learning** and evaluate supervised learning models using metrics such as **entropy, Gini index**, and **information gain**.

CO2 Apply basic ML algorithms such as **SVM, KNN, MLP, CART**, and **ensemble methods** to solve classification and prediction problems.

CO3 Derive and implement **linear regression** models using **least squares, regularization**, and **Bayesian approaches**, and analyze the bias–variance trade–off.

CO4 Build and compare **probabilistic generative** and **discriminative models** using Bayes theorem, discriminant functions, and Bayesian logistic regression.

CO5 Perform **clustering** and **dimensionality reduction** using K-Means, hierarchical clustering, Gaussian mixtures, EM algorithm, PCA, and LDA.

CO6 Apply **graphical models** (HMMs, Monte Carlo sampling) and apply **reinforcement learning** frameworks for sequential decision-making tasks.

SECTION 11A: Mapping between COs and POs / PSOs

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	-	-
CO2	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	-	✓
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	-	-	-	-	-	✓	✓	✓	✓

CO, PO, PSO Mapped with WKs

Mapping of COs with POs / PSOs and WKs (Attainment & Justification)

COs	POs	WKs (Bloom's Taxonomy Level)									IAs Count
		WK 1 Remember	WK 2 Understand	WK 3 Apply	WK 4 Analyze	WK 5 Evaluate	WK 6 Create	WK 7 Apply	WK 8 Evaluate	WK 9 Create	
		a b c d e f	a b c e f	a b e f	a b c e f	a b c e f	a b c e f	a b c e f	a b c e f	a b c e f	
CO 1	PO 1	● ● ● ●	● ● ● ●	● ● ●	● ●	● ● ● ●	● ●	●			10
	PO 2	● ● ● ●	● ● ●	● ● ●	●		● ●				10
	PO 3			● ● ●	●						4
	PO 11				● ● ●		● ● ●				5
	PSO 1	● ●			●			● ● ●	●		8
	PSO 3	● ● ● ●	● ● ●	● ●	●		● ●	●	●		10
CO 2	PO 1	● ● ● ●	● ● ●	● ● ●							10
	PO 2	● ● ● ●	● ● ●	● ● ●	●						10
	PO 3				● ●						4
	PO 4	● ●			●		● ● ●				5
	PO 5	● ● ● ●	● ● ●					● ●	● ●		9
	PO 11	●			● ● ●		● ●	●			5
	PSO 1	●					● ●		●		8
	PSO 3	● ● ● ●	● ● ●	● ● ●	● ●		● ●	●	●		10

Mapping of COs with POs / PSOs and WKs (Attainment & Justification)

	POs / PSOs	WK 1 Remember	WK 2 Understand	WK 3 Apply	WK 4 Analyze	WK 5 Evaluate	WK 6 Create	WK 7 Apply	WK 8 Evaluate	WK 9 Create	IAs Count
		a b c e f	a b c e f	a b e f	a b c e f	a b c e f	a b c e f	a b c e f	a b c e f	a b c e f	
CO 3	PO 1	● ● ● ●	● ● ●	● ●	● ●						10
	PO 2	● ● ● ●	● ●	● ●			●				10
	PO 3			● ●	● ● ●	●					4
	PO 4				● ● ●	●		●	● ●		5
	PO 5	● ● ●	● ● ●	●		● ●	●	●	●		9
	PO 11			●	● ●						5
	PSO 1	●			● ●						8
	PSO 2	● ● ● ●	● ● ●	● ●	● ●		● ● ●		● ●		10
	PSO 3	● ● ● ●	● ● ●	● ●	● ●			● ●	● ● ●		10
CO 4	PO 1	● ● ● ●	● ● ●	● ●	● ●	●					10
	PO 2	● ● ● ●	● ● ●	● ●							10
	PO 3			● ●	● ● ●						4
	PO 4				● ● ●	●		●	● ●		5
	PO 5	● ● ●	● ● ● ●				● ●		●		9
	PO 11			●	● ● ●	● ●					5
	PSO 1	●			● ●						8
	PSO 2	● ● ● ●	● ● ●	● ●	● ●	●	● ● ●		● ● ●		10
	PSO 3	● ● ● ●	● ● ●	● ●	● ●	●		● ●	● ● ●		10

Mapping of COs with POs / PSOs and WKs (Attainment & Justification)

COs	POs / PSOs	WK 1 Remember	WK 2 Understand	WK 3 Apply	WK 4 Analyze	WK 5 Evaluate	WK 6 Create	WK 7 Apply	WK 8 Evaluate	WK 9 Evaluate	IAs Count
		a b c d e f	a b c d e f	a b c d e f	a b c d e f	a b c d e f	a b c d e f	a b c d e f	a b c d e f	a b c d e f	
CO 5	PO 1	● ● ● ● ●	● ●	● ● ●	● ●						10
	PO 2	● ● ● ● ●	● ●	● ● ●					● ●		10
	PO 3			● ● ●	● ●	● ● ●			● ● ● ● ●		10
	PO 4				● ● ●	●	● ●	●			4
	PO 5	●	● ●		● ● ●	● ●					5
	PO 6	● ● ● ●	● ●	●			●		● ●		9
	PO 11				● ● ●				● ●		5
	PSO 1	●		● ●	● ●	● ● ●	●	● ●	● ●	● ●	8
	PSO 2	● ● ● ● ●	● ● ● ●	● ●	● ●	● ●	● ●	● ●	● ●	● ●	10
CO 6	PO 1	● ● ● ● ●	● ● ●	● ● ●	● ●						10
	PO 2	● ● ● ● ●	● ●	● ● ●					●		10
	PO 3			● ● ●	● ●	● ● ●	●	●	● ● ● ● ●		10
	PO 4				● ● ●	●	●	●			4
	PO 5	●	● ●		● ●	● ●					5
	PO 6	● ● ● ●	● ●	●			●		● ●		9
	PO 11				● ● ●				● ●		5
	PSO 1	●		● ●	● ●	● ● ●	●	● ●	● ●	● ●	8
	PSO 2	● ● ● ● ●	● ● ● ●	● ●	● ●	● ●	● ●	● ●	● ●	● ●	10

Course Articulation Matrix of COs to POs

SECTION 11B: Indicators of Attainment with COs to POs and PSOs

Course Outcomes	Percentage of Indicators of Attainments (IA) with POs and PSOs												
	POs										PSOs		
	1	2	3	4	5	6	7	9	10	11	1	2	3
CO1	67	67	67	-	-	-	-	-	-	71	53	-	-
CO2	67	67	67	71	82	-	-	-	-	71	53	-	90
CO3	67	67	67	71	82	-	-	-	-	71	53	90	90
CO4	67	67	67	71	82	-	-	-	-	71	53	90	90
CO5	67	67	67	71	82	-	-	-	-	71	53	90	90
CO6	67	67	67	71	82	80	-	-	-	71	53	90	90

SECTION 11C: Course Articulation Matrix of COs to POs

0	1	2	3
No Contribution (0–5%)	Low (≥5 – <40%)	Moderate (≥40 – <60%)	High (≥60%)

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	3	-	-	-	-	-	-	3	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	3	2	-	3
CO3	3	3	3	3	3	-	-	-	-	-	3	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	2	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	2	3	3
CO6	3	3	3	3	3	3	-	-	-	-	3	2	3	3
Total	18	18	18	15	15	3	-	-	-	-	18	12	12	15
Average	3	3	3	3	3	3	-	-	-	-	3	3	2	3

SECTION 11D: Level of Contribution of the COs to POs and PSOs

0	1	2	3
No Contribution (0–5%)	Low (≥5 – <40%)	Moderate (≥40 – <60%)	High (≥60%)

MECHANISM FOR THE ATTAINMENTS OF CO

CO ATTAINMENT (CIE or SEE)

$$\text{CO ATTAINMENT} = \frac{\text{No. of } \textit{students reached (threshold)} \text{ in answering the question}}{\text{No. of students attempted}} \times 100$$

OVERALL CO ATTAINMENT (DIRECT)

$$\text{Overall CO attainment (Direct)} = 0.30 \times \text{CIA} + 0.70 \times \text{SEE}$$

CO ATTAINMENT (INDIRECT)

$$\text{CO ATTAINMENT} = \frac{\text{No. of students } \textit{responses reached expected level} \text{ in answering the survey}}{\text{No. of students responded}} \times 100$$

WEIGHTAGE OF ATTAINMENT LEVEL

- Direct level 80%
- Indirect level 20%

CO ATTAINMENT

$$0.8 \times \text{CO attainment (Direct)} + 0.2 \times \text{CO attainment (Indirect)}$$

CO ATTAINMENT FRAMEWORK

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

KEY TAKEAWAY

CO attainment is calculated by combining direct and indirect assessments using appropriate weightage, ensuring a comprehensive and continuous improvement in teaching–learning outcomes.

MECHANISM FOR THE ATTAINMENT OF CO AND PO/PSO

CO ATTAINMENT (CIE or SEE)

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

Measures the extent to which students achieve the expected level in **direct assessments.**

OVERALL CO ATTAINMENT (DIRECT)

$$\text{Overall CO attainment (Direct)} = 0.30 \times \text{CIA} + 0.70 \times \text{SEE}$$

Weighted combination of Continuous Internal Assessment (**CIA**) and Semester End Examination (**SEE**).

CO ATTAINMENT (INDIRECT)

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

Measures the extent to which stakeholders perceive the attainment of COs through **indirect methods.**

PO / PSO ATTAINMENT FRAMEWORK

PO / PSO ATTAINMENT

80% of Direct Assessment (CO attainment of courses) + **10%** of Program Exit Survey + **5%** of Alumni Survey + **5%** of Employer Survey =

PO / PSO ATTAINMENT

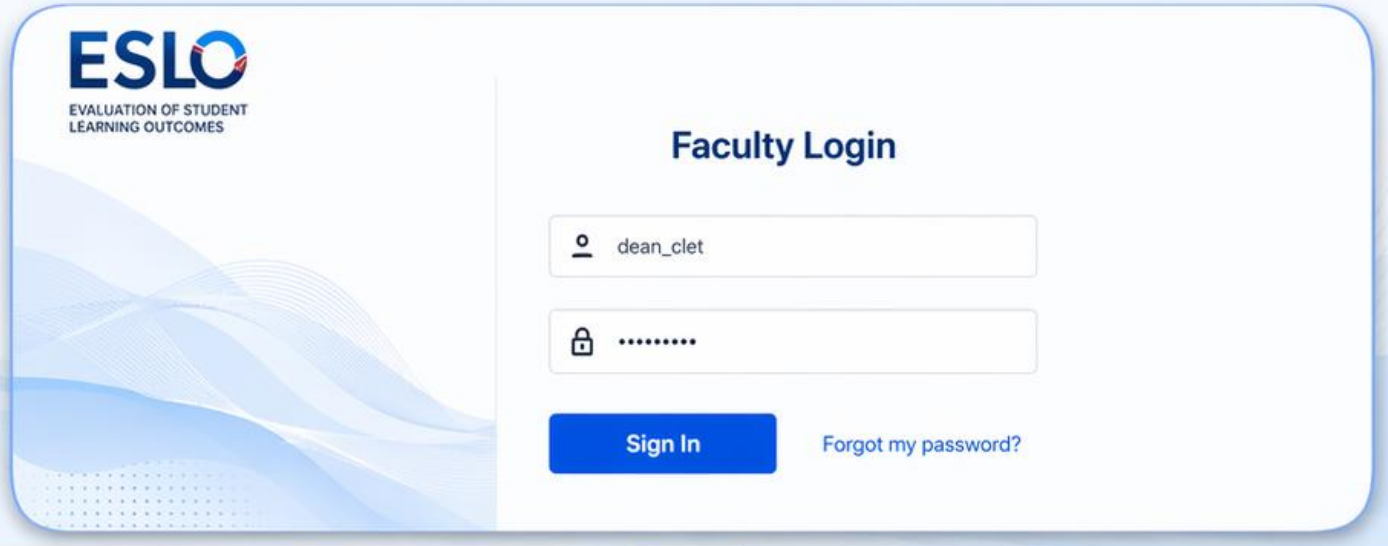
80% of direct assessment of CO + 10% of Program Exit Survey + 5% of Alumni Survey + 5% of Employer Survey

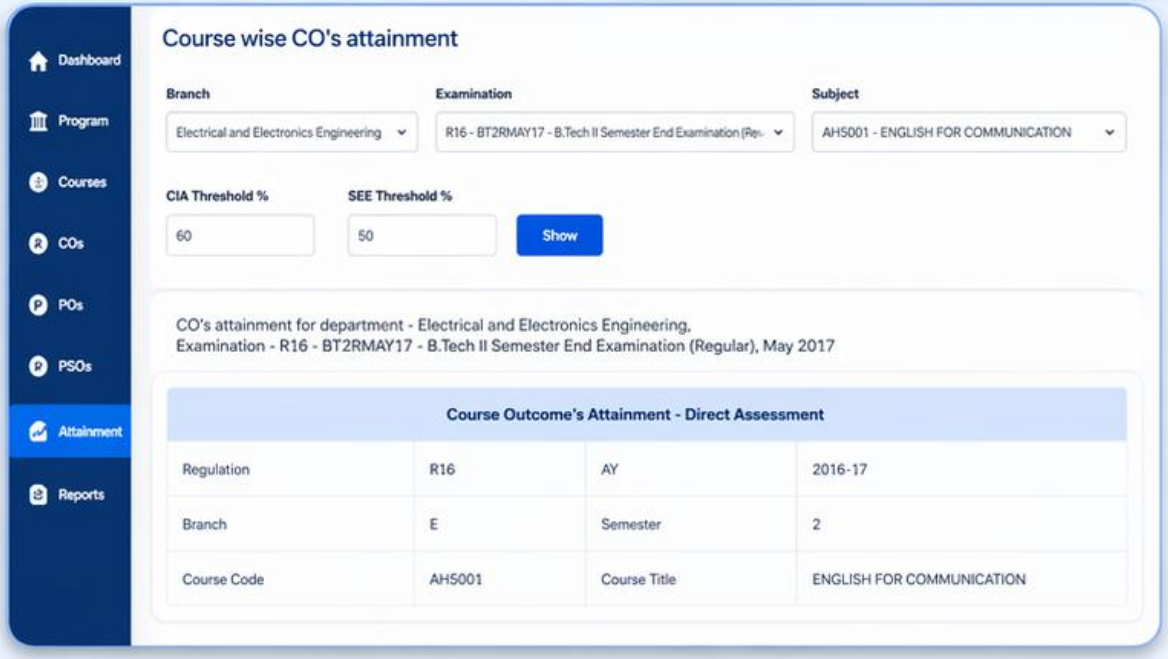
KEY TAKEAWAY

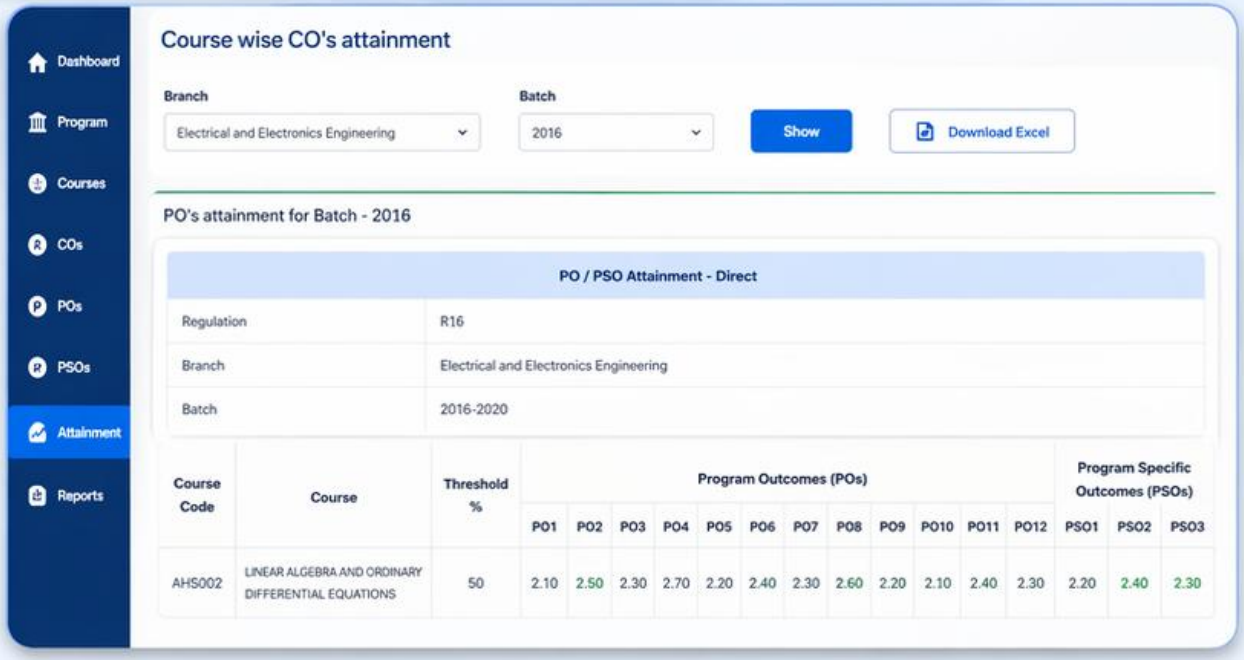
PO/PSO attainment is calculated by integrating **direct** and **indirect** assessments with appropriate weightage, ensuring a balanced and comprehensive evaluation of program outcomes.

This mechanism ensures **continuous improvement** and alignment with the vision and mission of the institution.

Evaluation of Student Learning Outcomes







ESLO

Evaluation of Students Learning Outcomes

A DIGITAL SYSTEM SUPPORTING OUTCOME-BASED EDUCATION (OBE)

ESLO measures what students know and can do after completing a course or program, ensuring **continuous improvement** in teaching–learning process.

IMPORTANT FUNCTIONALITIES

1 Provision for Faculty to Enter Outcomes

- Provision for faculty to enter program outcomes (POs), Course Outcomes (COs) and Program Specific Outcomes (PSOs).

• Course Outcomes • Program Outcomes • Program Specific Outcomes

2 CO/PO/PSO Entry

- In this section for each course, course outcomes will be adding and program outcomes and program specific outcomes will be entering for each program.

• Course Outcomes • Program Outcomes • Program Specific Outcomes

3 CO/PO/PSO Applicability

- Displays the number of COs defined, the POs and PSOs mapped for each course.

• Course Outcomes • Program Outcomes • Program Specific Outcomes

4 Course Articulation Matrix

- For each course, articulation matrix will be uploaded that is strength of correlation of COs with POs and PSOs.

• Correlation of COs with POs and PSOs

5 Program Articulation Matrix

- It is formed by the strength of correlation of COs with POs and PSOs for each course.

• POs, PSOs articulation matrix

6 COs Attainment Theory

- A set of performance evaluation criteria is used for quantitative assessment of COs. It shows the level of learning achieved between COs and POs for a course.

• Attainment of COs

7 COs Attainment Lab/Project

- The attainment of COs for Lab and Projects calculated.

• Attainment of COs

8 COs Attainment Report

- Shows the overall report of COs attainment for all the courses, branch wise and batch wise.

• Course wise COs report

9 CO Action Taken

- Describes the action taken in the cases where attainment of COs has not reached the target value.

• Attainment of COs

10 OBE Feedback Report

- The feedback about each course is collected from students based on various factors and a report on the same is given.

• OBE Feedback for each course

11 POs/PSOs Attainment

- Describes the level of attainment of POs and PSOs for each program.

• Attainment of POs and PSOs

12 CO's Attainment Summary

- Gives a complete summary of COs attainment for both CIA and SEE of each course.

• CO Attainment summary for each course

KEY FEATURES OF ESLO

- Digital entry of COs, POs, PSOs
- Automated mapping and attainment reports
- Question paper integration with Bloom's levels
- Annual outcome assessment reports
- Data-driven decisions for quality improvement

OUR COMMITMENT
Ensuring measurable outcomes and creating a culture of excellence.

OUR VISION
Transforming education through outcomes, assessment and continuous improvement.

OBE DOMINANT CRITERIA

01	Criterion 1	Outcome based Curriculum
02	Criterion 2	Outcome based Teaching Learning
03	Criterion 3	Outcome based Assessment
04	Criterion 6	Faculty Contributions
05	Criterion 8	Continuous Improvement

NEW NBA GUIDELINES

01 

Alignment of Knowledge Profiles for measurement of outcomes.

02 

Complex Engineering Problems (CEP) / activities as per definition of IEA.

03 

Sustainability issues to be addressed while solving CEP.

04 

Develop measurement tools (Rubrics) for Labs, PBL, Projects, Seminars carefully targeting the corresponding POs.

05 

Identify the courses/AATs which can be used to address SDGs apart from projects and keep a portfolio of evidences for those batch of students if possible.

06 

Concept of allied department and faculty requirement for SFR, Cadre proportion and retention ratio computations.

07 

Faculty contributions new criteria.

08 

There is no separate first year criteria.

09 

11 POs by NBA.

10 

9 criteria in SAR.

KEY ASPECTS NOTED IN NBA

1. More emphasis on OBC and OBE practices.
2. Action taken for CO attainment has been given more importance.
3. Improvement in SFR, Faculty Qualification/ Contribution, Research and Infrastructure is evaluated.
4. Term Work (TW) and Self Learning (SL) is considered in Curriculum Structure.
5. Implementation of ABC is emphasised.
6. Project Based learning is given higher emphasis. Mini Project/Micro Projects and Innovative Projects are encouraged.
7. MOOC/SWAYAM/NPTEL/Self Learning must be inline with PO's and PSO's.
8. Evaluation of Semester End Exam (SEE) Question Paper inline with constructive alignment of questions with COs and hence POs/PSOs.
9. Addressing Sustainable Development Goals.
10. Student Publication is given higher weightage.
11. Academic Performance of Third is added.
12. Faculty Retention Calculation norms has been updated.
13. Faculty Contribution in Development of SWAYAM MOOCs.
14. Memberships in Professional Committees at National/International Levels
15. Faculty Support in Student Innovative Projects
16. Faculty Internship/Training/Collaboration with Industry
17. Institution Seed Money or Internal Research Grant to its Teachers for Research Work
18. Agendas and minutes of Governing body and academic council/senate are also to be uploaded on the website of the institute.
19. Initiatives and Implementation Sustainable Development Goals
20. Strategy of implementing Educational Policy is additionally added.

CRITERION 1: OUTCOME-BASED CURRICULUM (120)

Sub-Criteria	Marks	Evaluation Guidelines	Exhibits/Context to be Observed/Assessed
1.1.5. Mapping of PEOs with Mission	10	A. Preparation of a matrix of PEOs and mission statement (05) B. Consistency/justification of correlation parameters of the above matrix (05)	**Exhibits/Context to be Observed/Assessed:** A. Availability of a matrix containing PEOs and Mission. B. Documentary evidence for justification for each statement mapped in the matrix.
1.2 Curriculum Structure and Features	30		
1.2.1. State the Process for Developing / Revising the Program Curriculum	10	Periodic review through search conferences/ curriculum development workshops, identifying job roles etc., taking into account the POs and PSOs. Involvement of the industry in this process.	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence demonstrating the process by which the program curriculum evolves and undergoes periodic review, taking into consideration POs and PSOs.
1.2.2. Curriculum Structure	10	Courses required for the degree program and distribution of learning hours assigned in terms of attaining POs and PSOs.	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence of the courses, including teaching methods and the number of credits, within the program curriculum.
1.2.3. Components of Curriculum	05	Verify curricular components for the attainment of POs and PSOs.	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence of Curriculum components.
1.2.4. Strategies for Education Reforms	05	Curriculum design in terms of various educational reforms such as multidisciplinary and interdisciplinary approaches, multi-point entry/exit options, academic bank of credits, skill- based courses, and recognition of prior learning, etc.	**Exhibits/Context to be Observed/Assessed:** • Evidence of the action plan for NEP 2020, state education policy, etc., including their implementations. Additionally, map activities in curriculum design with multidisciplinary and interdisciplinary programs, the establishment of an academic bank of credits system, and APAAR, etc.

Note: Numbers in brackets indicate distribution of marks.

Sr. No.	Criteria	Description	Marks
1.3.	**PO, PSO and their Mapping with Courses**		20
1.3.1	**POs and PSOs**	• **Listing of the Program Specific Outcomes** (up to 3) of the program under consideration and their appropriateness	05
1.3.2	**Mapping between the Courses and POs/PSOs**	• Justification of mapping between courses and POs and PSOs	15
		Exhibits/Context to be Observed/Assessed: • Availability & correctness of the PSOs statements • Documentary evidence of mapping of all courses with POs/PSOs	
1.4.	**Course Outcomes and Course Articulation Matrix**		30
1.4.1	**Course Outcome (Semester Wise)**	• Availability of appropriate COs for every course	15
		Exhibits/Context to be Observed/Assessed: • Documentary evidence of appropriateness of the CO statements.	
1.4.2	**Course Articulation Matrix**	• Availability of Course Articulation Matrix and its appropriateness in terms of level of correlation.	15
		Exhibits/Context to be Observed/Assessed: • Documentary evidence of justification of appropriateness of mapping of COs and correlation levels with various POs and PSOs	
1.5.	**Program Articulation Matrix**	• Availability of Mapping of Courses and POs / PSOs	05
		Exhibits/Context to be Observed/Assessed: • Documentary evidence of Articulation Matrix and relevance	
		Total:	120

Criterion	Sub-Criteria	Marks	Evaluation Guidelines
2.1. Describe Processes Followed to Ensure Quality of Teaching & Learning	**A.** Adherence to the Academic Calendar	02	**Exhibits/Context to be Observed/Assessed:** **A** Academic Calendar and its effective implementation. **B** Documentary evidence of supporting the implementation of pedagogical initiatives, such as real-life examples, collaborative learning, ICT-supported learning, and interactive classrooms. **C** Documentary evidence of tailored resources, differentiated instruction, and individualized attention to meet their unique learning needs **D** Classroom ambience and efforts to keep students engaged (also to be verified during interaction with the students). **E** Quality of laboratory experience concerning conducting experiments, recording observations, analysis, etc. (also to be verified during interaction with the students).
	B. Pedagogical Initiatives	05	
	C. Support students based on their ability	04	
	D. Quality of Classroom Teaching	04	
	E. Conduct of Experiments	05	
2.2. Quality of Student Capstone Project	**A.** Identification of capstone/ major project and allocation of guides	05	**Exhibits/Context to be Observed/Assessed:** **A** Capstone/major project identification and guide/ supervisor allocation process **B** Projects classification (application, product, research, review, etc.), incorporating factors such as environment, safety, ethics, cost, standards, and mapping with POs and PSOs. **C** Process for continuous monitoring (Meeting records with guide and its frequency etc.,) **D** Quality of projects, working models, or prototypes incorporating factors such as environment, safety, ethics, cost, standards, and mapping with POs and PSOs.
	B. Types and relevance of the capstone/major project and their contribution towards the attainment of POs and PSOs	06	
	C. Continuous monitoring process	04	
	D. Quality of completed projects/ working models /prototypes in relation to environment, sustainability, safety, ethics and cost	10	
2.3. Internship/ Industrial Training	**A.** Process of Internship/ Industrial training for students	03	**Exhibits/Context to be Observed/Assessed:** **A** Documentary evidence of process of internship/ industrial training for students, number of students participated, relevant training areas, documented visit report, with a duration of not less than 2 weeks for the industrial training/internship. **B** Documentary evidence of mapping of internship and training programs for students to POs and PSOs **C** Documentary evidence of student feedback on industrial training and its analysis and actions taken.
	B. Mapping of Industrial training/internships with POs and PSOs	04	
	C. Student feedback on training/internships and its analysis	03	
Total Marks			**120**

Criterion	Sub-Criteria	Marks	Evaluation Guidelines
2.4. Seminar and Mini/Micro Projects **Note:** Mini Projects are Course Projects and Micro Projects are Tasks	A Mapping of Seminars presented by the students with POs and PSOs	05	**Exhibits/Context to be Observed/Assessed:** A Documentary evidence of seminars presented by the students B Documentary evidence of Mini/micro projects and their mapping with POs and PSOs.
	B Mapping of the mini/micro project and their contribution with POs and PSOs	05	
2.5. Case Studies and Real-Life Examples	Use of case studies and real-life examples in teaching and their mapping with POs and PSOs.	10	**Exhibits/Context to be Observed/Assessed:** ● Documentary evidences of case studies and real-life examples and its mapping with POs and PSOs.
2.6. SWAYAM/NPTEL/ MOOC/Self Learning	A Number of students obtained MOOCs certification through platforms like SWAYAM/NPTEL, etc and their mapping with POs and PSOs	07	**Exhibits/Context to be Observed/Assessed:** A Documentary evidence of number of students cleared MOOCs B Evidence for Self-learning.
	B Scope for self-learning & facilities and its use.	03	
2.7. Solving Complex Engineering Problems Incorporating Sustainability Goals	List of complex engineering problems from different courses/activities/ mini projects, etc. along with the targeted SDGs.	20	**Exhibits/Context to be Observed/Assessed:** ● Documentary evidences of solving complex engineering problems targeting SDGs
2.8. Steps Taken for Enhancing Industry Institute Partnerships	A Industry involvement in the partial delivery of any regular courses for students	05	**Exhibits/Context to be Observed/Assessed:** A Documentary evidence of industry involvement in the partial delivery of any regular courses. B Documentary evidence of industry offered courses/training C Types of industries, types of labs, objectives, utilization, and effectiveness. D Analysis and actions taken as a result.
	B Industry offered courses/training	04	
	C Industry-supported laboratories	03	
	D Impact analysis and actions taken thereof	03	
TOTAL MARKS			**120**

Criterion	Sub-Criteria	Marks	Evaluation Guidelines
3.1. Evaluation of Continuous Assessment: Assignments, Unit Tests, Mid-Term, etc	A Process for setting and evaluation of internal semester question paper B Quality of questions, appropriateness of mapping with the COs C Assessment of COs coverage in unit tests/class tests/mid-term tests/assignments D Sharing of post evaluation feedback with students for performance improvement	10	**Exhibits/Context to be Observed/Assessed:** A Process for setting internal semester question papers, creating model answers, evaluating them, and ensuring compliance. B Assessment of the quality of unit tests/class tests/mid-term tests/assignments C Documentary evidence of mapping questions with COs. D Evidence of sharing of post evaluation feedback with students for performance improvement
3.2. Evaluation of Semester End Exam (SEE) Question Paper	A Process for setting and evaluation of semester-end exam question paper B Quality of questions, appropriateness of mapping with the COs C Transparency of post evaluation process	10	**Exhibits/Context to be Observed/Assessed:** A Process for setting semester-end exam question paper evaluating and ensuring compliance. B Assessment of the quality of semester end exam question paper C Evidence of transparency of post evaluation process
3.3. Evaluation of Laboratory Work and Workshop (Continuous and SEE)	A Evaluation of experiments conducted in workshops/laboratories B Use of Rubrics for assessing student performance with relevance to COs/POs	10	**Exhibits/Context to be Observed/Assessed:** A Evidence of evaluation of the laboratory experiments B Evidence of Rubrics developed and used for assessing student performance during workshops/laboratories.
3.4. Evaluation of Industrial Training/ Internship (Continuous and SEE)	A Relevance of internships / industrial training B Rubrics used for assessing student industrial training / internships and appropriateness of mapping with POs	10	**Exhibits/Context to be Observed/Assessed:** A Documentary evidence of internships/ industrial training and its relevance in terms of POs. B Evidence of Rubrics developed and used for assessing student performance during internships/ industrial training.
TOTAL MARKS		**120**	

		Sub-Criteria	Marks	Evaluation Guidelines
3.5. Evaluation of Projects Project Evaluation with Rubrics		A Rubrics used for assessing complexity, cost, relevance to the environment, and sustainability (10) B Rubrics used for assessing team work, communication, and use of project management concepts (10)	20	**Exhibits/Context to be Observed/Assessed:** A & B. Rubrics are used to assess complexity, cost, relevance to the environment and sustainability, individual student performance, and team performance.
3.6. Evidence of Addressing Sustainable Development Goals (SDG)		Evidence of Addressing Sustainable Development Goals relevant to the program	10	**Exhibits/Context to be Observed/Assessed:** • Student project activities through course work, research work and projects.
3.7. Attainment of Course Outcomes	**3.7.1.** Describe the Assessment Tools and Processes Used to Gather the Data For the Evaluation of Course Outcome	A List of assessment tools and processes (02) B The quality/relevance of assessment tools/processes used (03)	05	**Exhibits/Context to be Observed/Assessed:** A. & B. Documentary evidence for assessment tools and assessment processes used to measure COs including data collection, verification, analysis, and decision-making.
	3.7.2. Resord the Attainment of Course Outcomes of all Courses with Respect to Set Attainment Levels	Verification of the attainment levels as per the benchmark set for COs of all courses	20	**Exhibits/Context to be Observed/Assessed:** • Methodology to define set levels and its compliance; data collection, verification, analysis and decision making; details for one course per year of study to be verified
3.8. Attainment of Program Outcomes and Program Specific Outcomes	**3.8.1.** Provide Results of Evaluation of Each PO & PSO	A Verification of documents, results, and the level of attainment of each PO/PSO (10) B Assessment of overall levels of attainment (15)	25	**Exhibits/Context to be Observed/Assessed:** A. & B. Documentary evidence towards appropriate attainment levels for attainment of POs and PSOs from core courses to be verified. Additionally, at least two levels of POs and two levels of PSOs attainment shall be verified.
TOTAL MARKS				**120**

CRITERION 6: FACULTY CONTRIBUTIONS (120)

Sub-Criteria		Marks	Evaluation Guidelines	Exhibits/Context to be Observed/Assessed:
6.1. Professional Development Activities	**6.1.1. Memberships in Professional Societies at National / International Levels** Memberships in Professional Societies at National/International Levels.	05	• Faculty members who have active recognized professional memberships and their positions and contributions to professional societies during the assessment period	• Documentary evidence of professional memberships
	6.1.2. Faculty as Resource Persons or Participants in STTPs / FDPs			
	6.1.2.1. Faculty as Resource Persons in STTPs/FDPs	05	• An average of more than 3 faculty members from the Department served as resource persons in STTPs/FDPs during the assessment period (05) • An average of more than 2 and less than 3 faculty members from the Department served as resource persons in STTPs/FDPs during the assessment period (02)	**A & B:** Documentary evidence of resource persons in the relevant STTP/FDP program
	6.1.2.2. Faculty Members' Participation in STTPs/ FDPs	A faculty scores maximum five points for participation • Participation in 2 to 5 days Faculty/ Faculty development program: 3 Points • Participation in >5 days Faculty/ Faculty development program: 5 points • RDF= Number of faculty required to comply with the 20:1 student-faculty ratio in the Department alone, as per section 5.1 (RDF= DS/20). • For each year, Assessment Points (AP) = Sum of faculty participation score / 0.5 * RDF • Average assessment over last three years starting from CAYm1 (Marks limited to 05)		• Relevance of the STTP/FDP program • Number of days attended • Number of faculty member attended
	6.1.3. Faculty Contribution in Development of SWAYAM MOOCs and other E-Content			
	A Faculty member (s) involvement in developing SWAYAM MOOCs	04		Documentary evidence for developing SWAYAM MOOCs
	B Involvement of faculty members in developing E-Content	03		Documentary evidence for developing E-Content

TOTAL MARKS **120**

		Marks	Evaluation Guidelines
6.1.4. Faculty Certification of MOOCs through SWAYAM, etc	Percentage of faculty members in the Department obtained MOOCs certification through platforms like SWAYAM/NPTEL and marks distribution as follows: • > 30% of available faculty members in the Department obtained MOOCs certification through platforms like SWAYAM/NPTEL averaged during the assessment period (06–08) • > 20% and <30% of available faculty members in the Department obtained MOOCs certification through platforms like SWAYAM/NPTEL averaged during the assessment period (03–05) • < 20% of available faculty members in the Department obtained MOOCs certification through platforms like SWAYAM/NPTEL averaged during the assessment period (00–02)	08	Exhibits/Context to be Observed/Assessed: • Documentary evidence of the relevance of the course and other aspects.
6.1.5. FDP / STTP Organized by Department	• The minimum duration of FDP/STTP is 5 days. • 2 points per FDP/STTP, with a maximum of 4 marks per assessment year and a total maximum of 10 marks	10	Exhibits/Context to be Observed/Assessed: • Documentary evidence: Participation and resource person and duration.
6.1.6. Faculty Support in Student Innovative Projects	Percentage of faculty members in the Department supporting as a mentor, facilitator, etc. in student innovation projects in various events like hackathons, codeathons, ideathons, open research, etc. & marks distribution as follows: • > 30% of available faculty members in the Department support as a mentor, facilitator, etc. in student innovation projects in various events during the assessment period (07–10) • > 20% and <30% of available faculty members in the Department support as a mentor, facilitator, etc. in student innovation projects in various events in the past 3 years (04–06) • <20% of available faculty members in the Department support as a mentor, facilitator, etc. in student innovation projects in various events in the past 3 years (00–03)	10	Exhibits/Context to be Observed/Assessed: • Documentary evidence of faculty members' involvement in student innovation projects as mentors or facilitators.
6.1.7. Faculty Internship / Training / Collaboration with Industry	Percentage of faculty members in the Department, who have undergone faculty internships/trainings/ collaboration with industry & marks distribution as follows: • > 30% of available faculty members in the Department have undergone faculty internships/ trainings/ collaboration with industry averaged during the assessment period (07–10) • > 20% of and <30% available faculty members in the Department have undergone faculty internships/ trainings/ collaboration with industry averaged during the assessment period (04–06) • <20% of available faculty members in the Department have undergone faculty internships/ trainings/ collaboration with industry averaged during the assessment period (00–03)	10	Exhibits/Context to be Observed/Assessed: • Documentary evidence
6.2. Research and Development Activities **6.2.1.** Academic Research	Publications in Journals, conference papers, books, and book Chapters and marks distribution as follow: A. No. of Publications (04) B. Quality of publications (06)	10	Exhibits/Context to be Observed/Assessed: • Quality of publications and number of publications & documentary evidence.
6.2.2. Ph.D. Student Details	A. No. of students enrolled for Ph.D. degree in the Department during the assessment period (02) B. No. of Ph.D. graduated in the Department during the assessment period (03)	05	
6.2.3. Development Activities	A. Patents granted during the assessment period (04) B. Patents published during the assessment period (03) C. Working models and prototypes developed during the assessment period (03)	10	Exhibits/Context to be Observed/Assessed: A & B: Documentary evidence of patents granted/published C. Documentary evidence of working models and prototypes developed
6.2.4. Sponsored Research Project	Funded research projects from external sources; Cumulative during CAYm1, CAYm2 and CAYm3 • Amount >20 Lacs – 15 Marks • Amount >16 Lacs and < 20 lacs – 12 Marks • Amount >12 Lacs and < 16 lacs – 9 Marks • Amount > 8 Lacs and < 12 lacs – 6 Marks • Amount > 4 Lacs and < 8 lacs – 3 Marks • Amount > 1 Lacs and < 4 lacs – 1 Mark • Amount < 1 Lac – 0 Mark	15	
TOTAL MARKS			**120**

Sub-Criteria		Marks	Evaluation Guidelines
6.2.5. Consultancy Work	Consultancy work from external sources; Cumulative during CAYm1, CAYm2 and CAYm3 • Amount >20 Lacs – 15 Marks • Amount >16 Lacs and < 20 lacs – 12 Marks • Amount >12 Lacs and < 16 lacs – 9 Marks • Amount > 8 Lacs and < 12 lacs – 6 Marks • Amount > 4 Lacs and <8 lacs – 3 Marks • Amount > 1 Lacs and <4 lacs – 1 Mark • Amount <1 Lac – 0 Mark	15	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence, funding agency, amount, duration, outcome
6.2.6. Institution Seed Money or Internal Research Grant to its Faculty for Research Work	**A. Amount received** (3 marks) Institution Seed Money or Internal Research Grants received by faculty members; cumulatively during CAYm1, CAYm2, and CAYm3 • Amount > 6 Lacs – 3 Marks • Amount > 4 Lacs and < 6 lacs – 2 Marks • Amount > 2 Lacs and < 4 lacs – 1 Mark • Amount < 1 Lac – 0 Mark **B. Amount utilized** (2 marks).	05	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence: Amount, duration, outcome
TOTAL			**120**

CRITERION 8: CONTINUOUS IMPROVEMENT (80)

Sub-Criteria			Marks	Evaluation Guidelines
8.1. Actions Taken Based on the Results of Evaluation of the COs, POs, and PSOs	**8.1.1.** Actions Taken Based on the Results of Evaluation of the COs Attainment	A. Documentary evidences of identification of gaps in COs attainment (05) B. Plan of action to bridge the gaps/ improvement (05) C. Implementation (10)	20	**Exhibits/Context to be Observed/Assessed:** A, B & C: A few core course files in CAYm1, CAYm2, CAYm3 need to be scrutinized for the identification of gaps and shortfalls, along with documentary evidence for each CO.
	8.1.2. Actions Taken Based on the Results of Evaluation of the POs/PSOs Attainment	A. Documentary evidences of identification of gaps in POs/PSOs attainment (05) B. Plan of action to bridge the gaps/ improvement (05) C. Implementation (10)	20	**Exhibits/Context to be Observed/Assessed:** A, B & C: Documentary evidence of PO/PSO attainment files in CAYm1, CAYm2, and CAYm3 needs to be scrutinized for the identification of gaps and shortfalls, along with documentary evidence for each PO/PSO.
8.2. Academic Audit and Actions Taken thereof during the Period of Assessment		A. Availability of external academic audit process (02) B. Plan of action to address the recommendations (03) C. Record of actions/corrective measures taken during the assessment period (10)	15	**Exhibits/Context to be Observed/Assessed:** • Documentary evidence of academic audit: Assessment criteria, frequency, conduct mechanism, action plan based on audit, implementation, and effectiveness.
8.3. Improvement in Faculty Qualification / Contribution		Assessment is based on improvement, with CAYm3 considered as the base year, in the following areas: A. Improvement in the no. faculty with Ph.D. (06) • Avg. no. of faculty with Ph.D. over past 3 yrs > 60% of required – 06 • Avg. no. of faculty with Ph.D. over past 3 yrs > 40% of required – 04 • Avg. no. of faculty with Ph.D. over past 3 yrs > 20% of required – 02 B. Improvement in the no. of publications in peer reviewed journals (06) C. Improvement in the no. of publications in conferences (03)	15	**Exhibits/Context to be Observed/Assessed:** • A, B, C & D: Nos. in each year of the assessment; improvement considering CAYm3 as a base year
8.4. Improvement in Academic Performance		Assessment is based on improvement of academic performance, with CAYm3 considered as the base year, in the following areas: A. Academic Performance Index (API) of the First-Year Students (03) B. Academic Performance Index (API) of the Second-Year Students (03) C. Academic Performance Index (API) of the Third Year Students (04)	10	**Exhibits/Context to be Observed/Assessed:** A & B: Document evidence of improvements in classrooms, academic as well as research laboratories and simulation tools, emulator, the use of digital tools, interactive whiteboards, and other devices aim to enhance learning experiences etc.
TOTAL MARKS				**80**

In OBE,

we don't just teach for grades;
we map every course outcome (CO)
to program outcomes (POs) and measure attainment through rubrics,
turning curriculum design into
demonstrable competence at graduation

1. COURSE OUTCOMES

Define what students are expected to learn in each course (COs).

2. MAPPING

Map each CO to relevant Program Outcomes (POs).

3. MEASUREMENT WITH RUBRICS

Assess student performance using rubrics aligned to COs and POs.

4. ATTAINMENT ANALYSIS

Evaluate attainment levels for COs and POs.

5. CONTINUOUS IMPROVEMENT

Use data-driven insights to improve teaching, learning and curriculum.

RESULT:
DEMONSTRABLE COMPETENCE AT GRADUATION

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- Clear Expectations
- Measurable Outcomes
- Quality Assurance
- Employability & Readiness

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Thank You