Pune Vidyarthi Griha's

College of Engineering and Technology & G. K. Pate (Wani) Institute of Management, Pune-09.

OUTCOME BASED EDUCATION & ASSESSMENT(OBEA) MANUAL

DEPARTMENT OF MECHANICAL ENGINEERING

Vision Mission of the Institute

Vision of the Institute

"To Achieve Excellence in Engineering Education"

Mission of the Institute

- To satisfy all stakeholders
- To develop ethical, highly motivated engineering professionals with good human values, requisite skills and competencies
- To adopt innovative teaching mechanisms
- To promote research culture
- To contribute to country's economic developments
- To be responsive to changes in technology, socio-economic and environmental conditions

Vision Mission of the Department

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"To become premier source of competent Mechanical Engineers in the service of the society"

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- To extend state of the art facilities and opportunities for the holistic development of the students
- To transform students into competent engineers, entrepreneurs and researchers with strong ethical, social and human values
- To undertake innovative practices in teaching-learning processes
- To strengthen collaborations with other institutions and industries to promote research

- To adapt to changes in technology for socio-economic and sustainable development

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1. About Pune Vidyarthi Griha's, COET&GKPIOM, Pune

1.1 Brief History of PVG

Pune Vidyarthi Griha was established in 1909, by the group of dedicated and visionary social workers, primary aim being to provide education facilities to deserving students and facility deprived students. PVG's College of Engineering and Technology and G. K. Pate (Wani) Institute of Management was established as an unaided college in 1985 under the parent Institute PVG. PVGCOET is affiliated Savitribai Phule Pune University, approved by AICTE (All India Council for Technical Education) and by Government of Maharashtra. The Institute is accredited by NAAC with Grade 'A".

The Institute is offering following courses shown in Table.

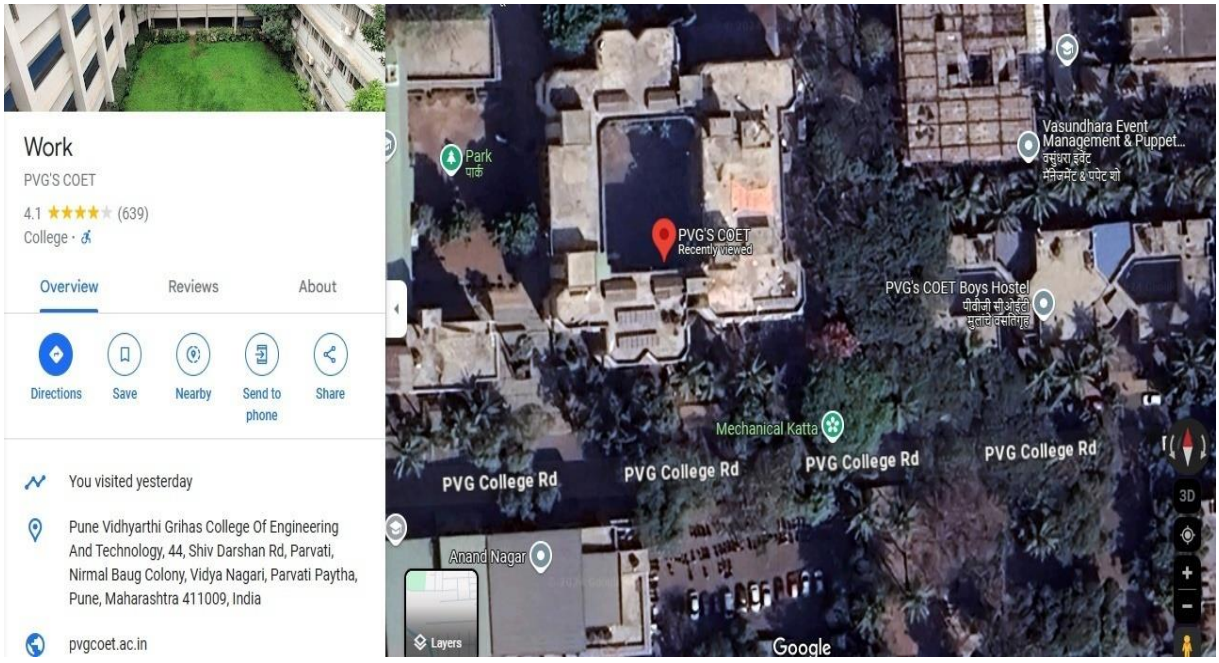
Name of Program	Program Level	Year of Start	Initial Intake	Sanctioned Intake
Printing & Packaging Technology	UG	1985	60	60
Mechanical Engineering	UG	1991	60	120
Electrical Engineering	UG	1991	30	60
E&TC Engineering	UG	1991	30	120
Information Technology	UG	2001	60	60
Computer Engineering	UG	2002	60	60
Artificial Intelligence and Data Science	UG	2021	60	60
Electrical Power System	PG	2000	18	18
Printing & Packaging Technology	PG	2009	18	9
Masters of Business Administration	PG	2011	60	60

Ph. D. Courses offered are outline in following Table.

Sr. No.	Name of Program
1	Electrical Engineering
2	Mechanical Engineering
3	Printing & Packaging Technology

1.2 Location:

The Institute is located in central place of Pune and is 15 kms from Airport and 8 kms from Pune Railway Station.



1.3 About Savitribai Phule Pune University

The Institute is affiliated to Savitribai Phule Pune University, one of the premier universities in India and is positioned in the North-western part of Pune city. It occupies an area of about 411 acres. It was established on 10th February, 1949 under the Poona University Act. The university houses 46 academic departments. It is popularly known as the 'Oxford of the East'. It has about 307 recognized research institutes and 612 affiliated colleges offering graduate and under-graduate courses. The university attracts many foreign students due to its excellent facilities. It offers good accommodation facility. There is a provision of hostel for the students. There is a well-stocked library containing plenty of books regarding various subjects. The university offers different scholarships to the students. The university conducts seminars and conferences for the students.

1.4 NATIONAL BOARD OF ACCREDITATION (NBA)

The National Board of Accreditation (NBA), India was initially established by the AICTE (All India Council of Technical Education) under section 10(u) of AICTE Act, in the year 1994, in order to assess the qualitative competence of the programs offered by educational institution from diploma level to post-graduate level in engineering and technology, management, pharmacy, architecture and related disciplines, which are approved by AICTE. NBA came into existence as an independent autonomous body with effect from 7th January 2010 with the objectives of assurance of quality and relevance to technical education, especially of the programs in professional and technical disciplines, i.e., Engineering and Technology, Management, Architecture, Pharmacy and Hotel Management and Catering Technology, through the mechanism of accreditation of programs offered by technical institutions. The Memorandum of Association and Rules of NBA were amended in April 2013, to make it completely independent of AICTE, administratively as well as financially. The NBA conducts evaluation of programs of technical institutes on the basis of laid down norms. This may include, but not limited to institutional missions and objectives, organization and governance, infrastructure facilities, quality of teaching and learning, curriculum design and review, support services (library, laboratory, instrumentation, computer facilities, etc.) and any other aspect as decided by the General Council and / or Executive Committee of NBA, which will help the graduates produced by the institutions as per industry requirements. Over the period of its existence, the NBA has introduced a new processes, parameters and criteria for accreditation that are in line with the best international practices and oriented to assess the outcomes of the programme.

1.5 NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL (NAAC)

The NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL (NAAC) conducts assessment and accreditation of Higher Educational Institutions (HEI) such as colleges, universities or other recognized institutions to derive an understanding of the 'Quality Status' of the institution. NAAC evaluates the institutions for its conformance to the standards of

quality in terms of its performance related to the educational processes and outcomes, curriculum coverage, teaching-learning processes, faculty, research, infrastructure, learning resources, organization, governance, financial wellbeing and student services.

2. Implementation of Outcome Based Education Philosophy at PVG'S COET&GKPIOM

2.1 Philosophy at PVG'S COET&GKPIOM (OBE)

OBE refers to the alignment and structuring of an institution's programs and teaching strategies around specific, well-defined outcomes that all students are expected to achieve upon graduation. The adoption of outcome-based education (OBE) in higher technical education commenced in India as well. The National Assessment and Accreditation Council (NAAC) and the National Board of Accreditation (NBA) serve as independent organizations dedicated to enhancing global quality standards in technical education within the country. Since 2013, the NBA has exclusively accredited programs that implement OBE. Furthermore, the National Board of Accreditation requires institutions to foster a culture centered around outcome-based education. Outcome-based education represents a shift from the conventional emphasis on institutional offerings to a focus on students' ability to demonstrate their knowledge and skills upon completing a course or program. This model signifies a transformation in the educational paradigm, prioritizing learning outcomes over teaching processes. All educational activities conducted within an Outcome-Based Education (OBE) framework should assist students in reaching the established objectives. Faculty members may modify their roles to serve as instructors, trainers, facilitators, or mentors, depending on the desired outcomes. The OBE approach represents an ongoing educational process that involves the continual enhancement of the curriculum, teaching methodologies, and assessment instruments. The learning process within OBE can be articulated in four distinct steps.

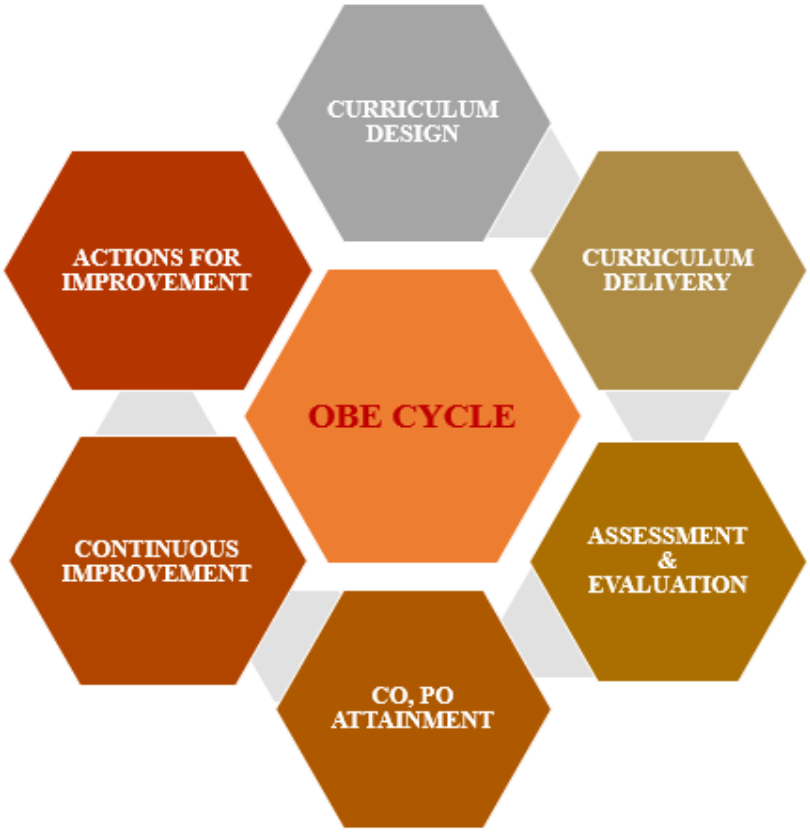
(a) Plan (Syllabus Writing/Review) — The Course Learning Outcomes are aligned with the PEO and Student Outcomes. The syllabi reflect strategies (learning plan) for achieving the outcomes, as well as for measuring the outcomes (assessment).

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

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

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

Outcome-based education represents a significant transformation in higher education, emphasizing a student-centered and results-driven approach.



2.2 Features of OBE:

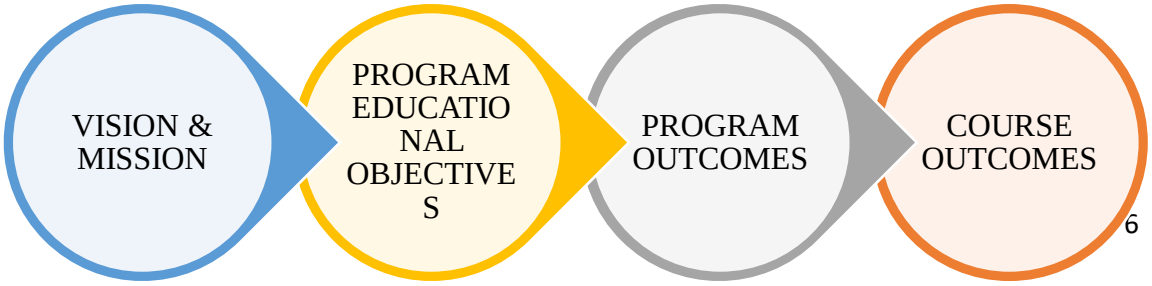
- OBE emphasizes the outcomes students should achieve and the skills they need to develop post-instruction
- It necessitates a transformation in curriculum design, assessment, and reporting to prioritize mastery of advanced learning over mere credit accumulation

- This approach moves away from conventional teaching methods that focus on rote memorization and standard procedures, ensuring students acquire essential skills and knowledge

2.3 Implementation of OBE

- Define the Vision and Mission statements for both the Institute and its respective department.
- Define Program Educational Objectives
- Program Outcome& Program Specific Outcome Statements
- Define Course Objectives
- Map course outcomes with program outcomes
- Define Course Outcomes with Bloom's Taxonomy for each course
- Mapping of topics with Course outcomes
- Prepare lecture-wise Course Lesson Plan
- Define pedagogical tools for course outcomes delivery
- Define rubrics for Project Based Learning, Practical, seminar, Mini Project, Final year Project
- Define various assessment tools such as Assignments, Quizzes, Class Test, Course End Survey
- Measure the attainment of each Course Outcome through Direct/Indirect assessments
- Monitor the academic progress of students
- Identify Gaps in the Curriculum and plan appropriate measures to bridge the Gap
- Compare PO/PSO for last 3 academic years and propose remedial actions
- Assess the attainment of Program Educational Objectives

Components of Outcome based education (OBE) are shown below.



The outcome-based education system is vastly different from the traditional educational approach and focuses on course and program outcomes. Moreover, teachers implement the approach with the following components:

1. Vision

2. Mission

3. PEOs

4. POs

5. Course Outcomes

VISION

Vision is a picture of the future, which seek to create and described in the present tense, as if it is happening at present. It shows a future path and predicts the outcome after system implementation.

MISSION

Mission statement defines what an institution is, why the institution exists, reason for its existence. It defines what we are here to do together.

VISION VS MISSION

VISION	MISSION
• A vision statement is what the Institute wants to acquire • A vision statement describe show the future will look if the Institute achieves The mission • A vision statement describes aPicture of the"preferred future"	• A mission statement is what an Institute is all about. • A mission statement explains what the Institute does, for whom and who will be benefited. • A mission statement gives the overall purpose of an Institute.

2.4 Vision and Mission of the Institute:

Vision of the Institute

"To Achieve Excellence in Engineering Education"

Mission of the Institute

- To satisfy all stakeholders
- To develop ethical, highly motivated engineering professionals with good human values, requisite skills and competencies
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- To extend state of the art facilities and opportunities for the holistic development of the students
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- To adapt to changes in technology for socio-economic and sustainable development

2.6 Program Educational Objectives (PEOs): Graduates will be able to

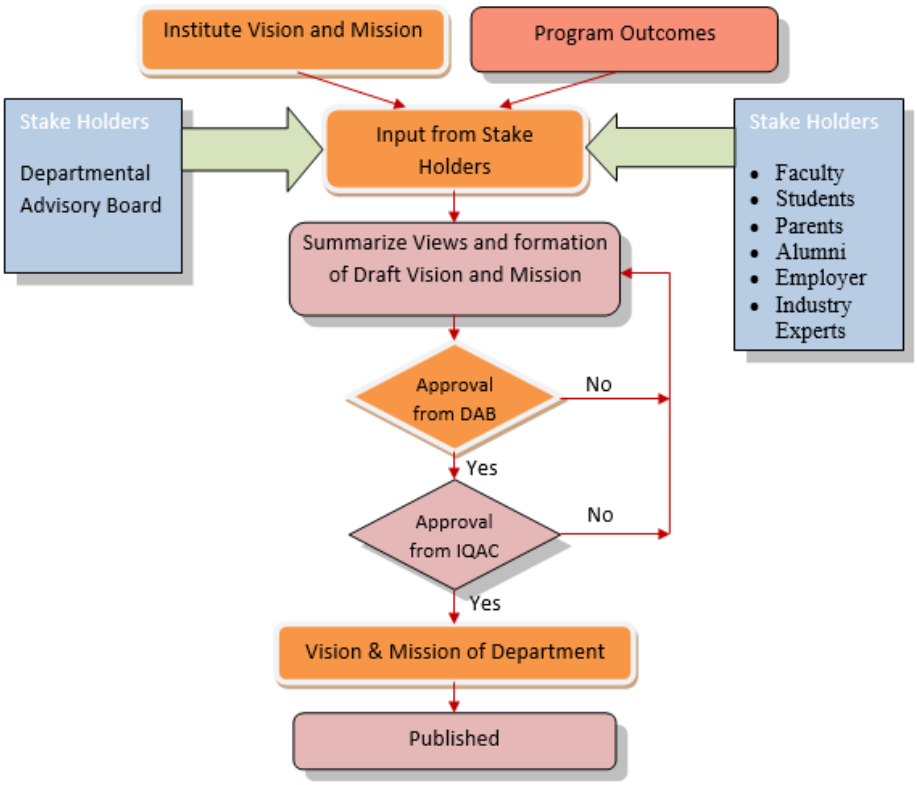
- **PEO-1:Apply** the technical skill to identify, analyze and solve engineering problems
- **PEO-2**: **Develop** the entrepreneur and researcher with ethical and human values
- **PEO- 3 : Analyze** the complex problems by using innovative modern tools
- **PEO-4: Develop** professionals having administrative and managerial skills for mechanical and multi-disciplinary domains.
- **PEO-5: Demonstrate** the attribute of self-directed learning capabilities (lifelong

learning) and cater to the needs of environment and society.

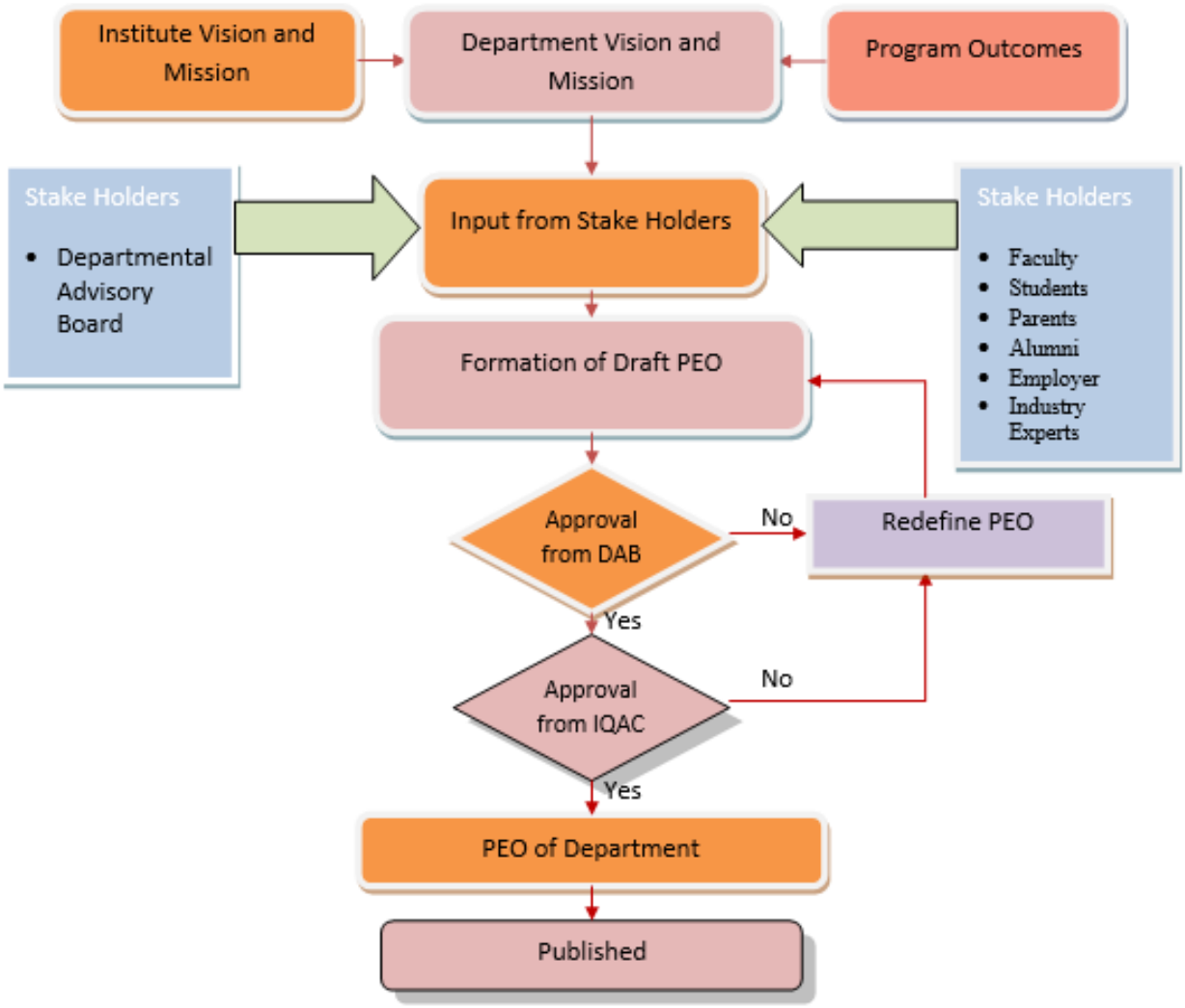
Program Educational Objectives (PEOs)

PEO	Statement	PO Mapped
PEO1	**Apply** the technical skill to identify, analyze, and solve engineering problems	PO1, PO2, PO3
PEO2	**Develop** the entrepreneur and researcher with ethical and human values	PO8
PEO3	**Analyze** the complex problems by using innovative modern tools	PO4, PO5
PEO4	**Develop** professionals having administrative and managerial skills for mechanical and multi-disciplinary domains	PO9, PO10, PO11
PEO5	**Demonstrate** the attribute of self-directed learning capabilities (lifelong learning) and cater to the needs of environment and society	PO6,PO7, PO12

2.7 Process for defining the Vision and Mission of the Department



2.8 Process for defining the PEOs of the Programme



2.9 Consistency of PEOs with Mission of Department

PEO	PEO Statements	M1	M2	M3	M4	M5
PEO1	**Apply** the technical skill to identify, analyze, and solve engineering problems	**3**	**3**	**3**	**3**	**2**
PEO2	**Develop** the entrepreneur and researcher with ethical and human values	**2**	**3**	**2**	**3**	**2**
PEO3	**Analyze** the complex problems by using innovative modern tools	**2**	**2**	**3**	**2**	**2**
PEO4	**Develop** professionals having administrative and managerial skills for mechanical and multi-disciplinary domains	**2**	**2**	**2**	**3**	**1**
PEO5	**Demonstrate** the attribute of self-directed learning capabilities (lifelong learning) and cater to the needs of environment and society	**3**	**3**	**1**	**2**	**3**

Statement: PEO-1	Justification		Activities Conducted
PEO-1: Apply the technical skill to identify, analyze, and solve engineering problems	**M1**	**HIGH** Quality education helps in strengthening the technical skills through the knowledge of Mechanical Engineering	• Syllabus • Projects • NPTEL course • Virtual labs data
	M2	**HIGH** Alumni help in providing guest lectures and skill development and share experience as a entrepreneur and researcher	• Alumni guest lecture • Contribution in lab development • Alumni involve Project expert • Helps in Internships
	M3	**HIGH** Provide excellent quality education to meet the challenges in the field of innovation through centre of excellence.	• Projects in Product innovation Lab, • Projects Robotics Lab • Projects BAJA/SUPRA Lab • 3 D printing Excellence centre
	M4	HIGH Strong MoUs help in providing industrial visit and internship and develop the skill towards research	• Departmental MOU • Industrial visit • Internship data
	M5	MEDIUM Technical skills help their progress in moral and social responsibilities	• Project based learning • Skill development initiates

Statement: PEO-2	Justification		Activities Conducted
PEO-2: Develop the entrepreneur and researcher with ethical and human values	**M1**	**MEDIUM** Through the competent technical skill of mechanical engineering graduates will achieve social and ethical development	• Projects on societal issue and environment • Projects of Product innovation lab
	M2	**HIGH** Provide the quality education for startup as an entrepreneur and excellence towards the research	• Entrepreneur of department ED cell activates
	M3	**MEDIUM** Improving academics by conducting workshops and guest lectures	• Guest lecturers conducted in department (improved)
	M4	**HIGH** Develop students through industry sponsored projects, technical training in industry	• Industry sponsored projects • Internship data • Skill development initiates
	M5	**MEDIUM** Awareness about a new technology for the improvement of social and environment needs	• LabVIEW software • Ansys software • solid modelling software • Robot programming software • 3 D printer

Statement: PEO-3	Justification		Activities Conducted
PEO-3: Analyze the complex problems by using innovative modern tools	**M1**	**MEDIUM** Providing state of art facilities and opportunities which matches with higher education and placement	• Projects in Product innovation Lab, • Projects Robotics Lab • Projects BAJA/SUPRA Lab
	M2	**MEDIUM** Promote excellent basic and fundamentals of technical skill to contribute in the field of R&D and industrialization	• Industry based project • Students publications • Patents
	M3	**HIGH** Highly technocrats can be boon towards fulfilling needs of industries and society	• Students Projects • Guest lectures • Industrial Visit
	M4	**MEDIUM** In collaboration with industry, development plays a key role in providing faceted training that can be considered as ready engineers	• Industry sponsored lab • Industrial Visit • Departmental MoU • Project Based Learning • Internship
	M5	**MEDIUM** Competent mechanical engineers will be able to make professional decisions by keeping lifelong learning and environmental awareness in mind	• Projects in 3D printing Lab • Robotics and Automation Lab

Statement: PEO-4	Justification		Activities Conducted
PEO-4: Develop professionals having administrative and managerial skills for mechanical and multi-disciplinary domains	**M1**	**MEDIUM** Individual students' development can be achieved by applying ethical and environment awareness to take professional decisions	• Project Based Learning • Internships • Students Patents • Students Publications Departmental Projects
	M2	**MEDIUM** Delivering ready engineers where these ready engineers offer sustainable solutions through technological competency, leadership skills and teamwork	• Paper Presentation • Group discussion • Departmental Projects • ED Cell activities
	M3	**MEDIUM** Focus on designing and *developing products* by using principles of science and technology	• Project Based Learning • Departmental Projects • Students Patents • Publication of students and facilities
	M4	**HIGH** Developing excellent technical facilities in academic and research enabling graduates to develop effective technical and communication skill as per the needs of industry and society.	• Projects in Product innovation Lab, • Projects Robotics Lab • Projects BAJA/SUPRA Lab • 3 D printing Excellence Centre
	M5	**MEDIUM** Sustainable development involves leveraging innovative solutions, digital transformation, and interdisciplinary approaches.	• Conducive Teaching Learning • Project Based Learning • Internship • LAB experiment • Students Project

Statement: PEO-5	Justification		Activities Conducted
PEO-5: Demonstrate the attribute of self-directed learning capabilities (lifelong learning) and cater to the needs of environment and society	**M1**	**HIGH** Quality education leads to better decision making and problem solving for holistic development	• Paper presentation • Publication \Patents • Project based learning • Participation in inter institute events
	M2	**HIGH** Imparting effective communication helps them to be a successful entrepreneur in society	• Paper presentation • Workshops/Seminars • MESA activities • ASM Robotics • IEI chapter
	M3	**MEDIUM** Basic knowledge of mechanical engineering will be applied for innovations	• Project based learning • Projects in Product innovation Lab, • Projects Robotics Lab • Projects BAJA/SUPRA Lab • 3 D printing Excellence Centre
	M4	**MEDIUM** Attaining excellence in mechanical engineering principles and practices produce best engineers of society	• Projects • Result Analysis • Publications • Patents • BAJA /SUPRA activates
	M5	**HIGH** Focus on ready to employ engineers which resembles by continuation of professional development and lifelong learning	• ED cell activities • Placement • Higher education

3. Course Outcomes, Program Outcomes and Program Specific (COs, POs and PSOs)

3.1 GRADUATE ATTRIBUTES (GA'S)

WA (Washington Accord) defines 12 GAs for Engineering Graduates.

1. **(KB) Engineering Knowledge:** A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **(PA) Problem analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions
3. **(Inv.) Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. **(Des.) Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **(Tools) Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **(Team) Individual and teamwork:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **(Comm.) Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

8. **(Prof.) Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **(Impacts) Impact of engineering on society and the environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **(Ethics) Ethics and equity:** An ability to apply professional ethics, accountability, and equity.
11. **(Econ.) Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **(LL) Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

3.2 PROGRAM OUTCOMES (POs)

Programme Outcomes (POs) describe what students should know and be able to do at the end of the programme. They are to be in line with the graduate attributes (GAs) of NBA. POs are to be specific, measurable and achievable.

Program Outcomes

Graduates of the mechanical engineering program will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3.3. PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Demonstrate competency in the area of Thermal, Design, Manufacturing and to apply skills in multidisciplinary areas of engineering
2. Face competitive examinations that offer challenging and rewarding careers (pursuing higher studies, general administration or entrepreneurship) in mechanical engineering or other areas.

3.4 BLOOM'S TAXONOMY

There are six levels of cognitive learning according to the revised version of Bloom's Taxonomy. Each level is conceptually different. The six levels are remembering, understanding, applying, analyzing, evaluating, and creating. Bloom's Taxonomy is frequently used in writing the course outcomes as it provides a readymade structure and list of action verbs. All levels of Bloom's taxonomy of thinking skills can be incorporated into expected learning outcome statements.

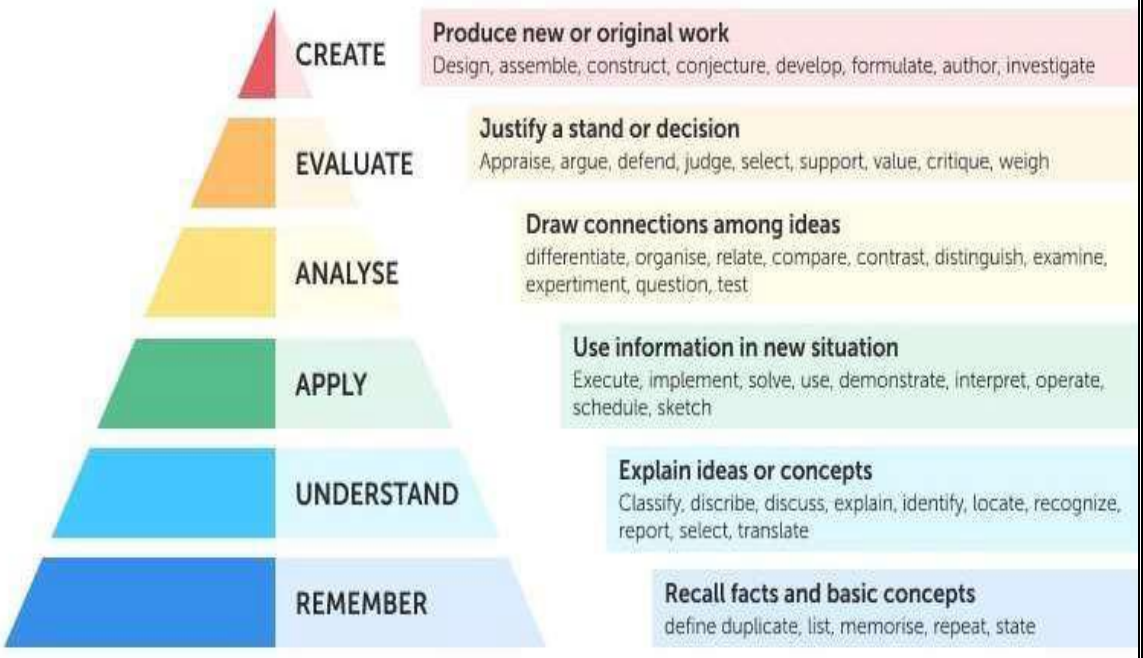


Figure 3.1 Pictorial representation of Blooms Taxonomy

Leve1: Remember

This stage of learning is about memorizing basic facts, dates, events, persons, places, concepts and patterns.

At this level, educators might ask learners simple questions like:

- What is the typical food eaten in India?
- What is the composition of greenhouse gases?
- Who was the first president of India? ·

The associated cognitive processes, as already noted, are: ·

- **Recognizing** means locating knowledge in long-term memory related to presented material (e.g., recognizing the dates of important historical events).
- **Recalling** is retrieving knowledge from long-term memory (e.g., recalling the dates of important historical events). ·

Level 2: Understand

At this point, learners might be asked to explain a concept in their own words, describe a mathematical graph or clarify a metaphor. The processes associated with understanding are:

- **Interpreting** implies changing from one form of representation to another. It might be transforming numerical information into verbal. ·
- **Exemplifying** is finding a specific illustration of a concept or principle. It may be giving several examples of Suprematist paintings. ·
- **Classifying** is determining a category of something. An example is the classification of mental disorders. ·
- **Summarizing** means retrieving a general theme of significant points (e.g., writing a short summary of a story). ·
- **Inferring** is drawing a logical conclusion from given information. It may be formulating grammatical principles of a foreign language from the presented examples. ·

- **Comparing** is finding correspondences between two ideas or objects (e.g., comparing historical events to their contemporary analogues). ·
- **Explaining** is constructing a cause-and-effect model of a system, for example, explaining the causes of the French Revolution. ·

Level 3: Apply

Now, it's time to use learned facts and abstractions in new contexts and particular situations.

For example, students might be asked to discuss phenomena described in one scientific paper using terms and concepts of another paper.

The processes of cognition corresponding to this stage are:

- **Executing** is applying a procedure to a familiar task (e.g., calculating the root of a number). ·
- **Implementing** is about applying a procedure to an unfamiliar task (e.g., using Newton's Second Law in a new situation). ·

Level 4: Analyze

At this level, students are supposed to break down concepts and examine their relationships. For instance, they might be asked to recognize the genre of a painting or describe the leading causes of the Great Depression.

The three particular processes associated with this stage are

- **Differentiating** means distinguishing important from unimportant parts of presented material (e.g., distinguishing between relevant and irrelevant numbers in a mathematical word problem). ·
- **Organizing** involves identifying how elements fit or function within a structure (e.g., finding the hypothesis, method, data and conclusion in a research report). ·
- **Attributing** means determining a point of view, bias, values, or intent underlying presented material. An example would be to identify the author's point of view of an essay. ·

Level 5: Evaluate

In this stage, learners are expected to use their knowledge and skills to appraise a situation, justify their stand or criticize others' opinions. They should be able to point out logical fallacies in arguments or compare a work to the highest standards in its field.

They might be asked, for example:

- In your opinion, is online piracy ethical?
- Do you consider jazz music to be high art?
- What are the most absurd arguments against vegetarianism?

Evaluating is divided into checking and critiquing.

- **Checking** means detecting inconsistencies or fallacies in a process or product. For example, it's determining if a scientist's conclusions follow from observed data.
- **Critiquing** involves finding inconsistencies between a product and external criteria. For instance, it's judging which of two methods the best for solving a problem.

Level 6: Create

This is the most complex stage of the learning process and the top of the revised Bloom's Taxonomy. At this level, learners combine known patterns, ideas and facts to create original work or formulate their solution to a problem.

They might be asked to compose a song, rewrite a story in another setting or formulate a hypothesis and propose a way of testing it. The three associated cognitive processes are:

- **Generating** involves coming up with alternative hypotheses based on criteria. An example might be devising multiple solutions for a social problem.
- **Planning** is about coming up with a procedure for completing a task (e.g., preparing an outline of an article).
- **Producing** means inventing a product (e.g., writing a short story that takes place during the American Revolution).

3.5 COURSE OUTCOMES (COS)

COs are the statements of Knowledge/ Skills/ Attitude that students are expected to know, understand and perform, as a result of learning experiences. Course Outcome remains the base of the hierarchy of outcomes and is the tools that can be used to measure student performance in each course. The course outcomes need to be concise descriptions of what learning is expected to take place by course completion.

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

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

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

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

3.5.1Writing/ Framing COs

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

- The CO statements are defined by considering the course content
- The statements are aligned to the learning that results from the course
- The statements are student centric
- For every course there are 6 Course Outcomes having action
- The keywords used to define CO are based on Bloom's Taxonomy.

3.5.2. Structure of Course Outcomes:

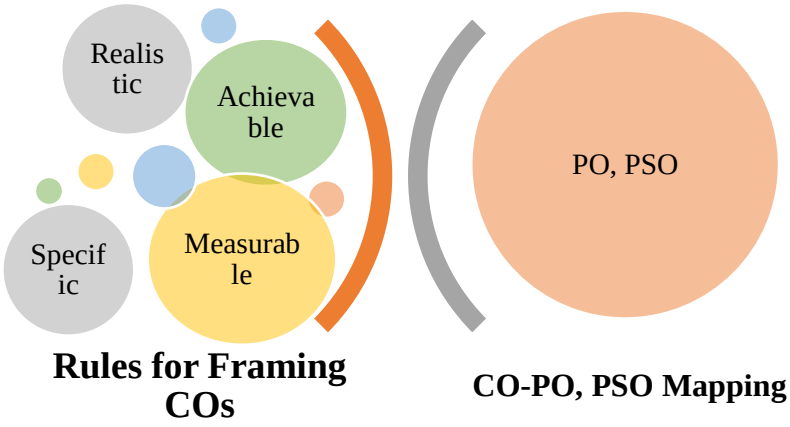
- The course outcomes must state the major knowledge, skills, attitude, or ability that students will acquire.
- Course outcomes should be expressed in terms of measurable and/or observable behaviours
- Course Outcomes should be agreed upon by the faculty in a program and should drive program outcomes.

- Course outcomes should begin with an action verb (e.g., write, install, solve, and apply).
- It would be better to map the course outcomes to the learning domain in Blooms or other Taxonomy.
- All courses having Five to Six course outcomes (COs) having action verbs according to Educational Taxonomy in-
  - Cognitive domain: Cognitive domain-defining knowledge classification.
  - Affective domain: Defining behaviours that correspond to attitude and values.
  - Psychomotor domain: Defining physical skills or task classification.

3.5.3. Course Objectives Vs Course Outcomes

Following table clarifies the difference between Course Objectives Vs Course Outcomes

Course Objectives	Course Outcomes
Describe what a teacher needs to teach, and what needs to be planned to teach.	Describe what students should demonstrate Upon the completion of a course.



3.5.4. Specific Learning Outcomes (Slo's) Or Learning Outcomes (Lo's)

Learning outcomes (LO's) or Specific Learning Outcomes (SLO's) are "statements of what is expected from the student which will be able to do as a result of learning the

activity". (Jenkins and Unwin, 2001);i.e. at the end of each unit or chapter. SLO's should also be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the unit.

4. Curriculum Implementation and Assessment Procedure

One of the key phases of curriculum development is curriculum implementation. It comes after curriculum development and design. Since it turns a blueprint into reality in the shape of a curriculum, any institution should take it thoroughly. It is believed that failure results from a well-designed project that is poorly executed. The rationale behind implementing an outcome-based curriculum correctly is covered in length in this chapter.

4.1 Program Assessment and Quality Improvement Committee (PAQIC)

The composition of PAQIC is as shown below:

Roles & Responsibilities		
Framing the procedures for academic assessment in the department Assist faculties for the achievements of Program Outcomes (POs), Program Specific Outcomes (PSOs) Coordination between Accreditation Coordinator and faculties Organize meeting of all members Preparation of report of academic assessment process	Academic Coordinator	Convener
To assist the academic coordinator in framing the procedures for academic assessment in line with the accreditation requirement Monitoring the achievements of Program Outcomes (POs), Program Specific Outcomes (PSOs) which meets the accreditation requirement	Accreditation Coordinator	Member
Motivating/Assisting faculties and students in research activities, paper publications etc.	R & D Coordinator	Member
Coordination between Dean IQAC and Head of Department	QA Coordinator	Member
Coordination between faculties and students, Making necessary arrangements for guest lectures for addressing POs and PSOs and record keeping	MESA Incharge	Member
Keeping record of the T & P activities/training imparted pertaining to student development and	T & P Coordinator	Member

providing		

Before the commencement of the semester, the academic coordinator distributes the academic record file (ARF) for maintaining the course delivery and assessment records for the respective course. The contents of ARF are shown below.

4.2 Index of ARF file

Index of ARF file

SR. No.	DESCRIPTION		PAGE NO
1	**Program Educational Objectives**		1
2	**Program Outcomes and Program Specific Outcomes**		2
3	**Course-level CO-PO and CO-PSO Matrix**		3
4	**Curriculum Book**		4
5	**Timetable**		5
6	**University Syllabus**		6
7	**Teacher's Manual**		7
8	**Lecture Plan**		8
9	**Unit wise Objectives**		9
10	**Resources used**		10
11	**Innovative Teaching Mechanisms**		11
12	**Self-learning Facilities**		12
13	**Contents Beyond Syllabus (Implementation details including Guest lecture organized/Online course for reference etc)**		13
14	**Remedial Teaching**		14
15	**Outcome Assessment**		
	a	**Quality of internal question papers and assignments (Documents related to mapping of questions with learning levels and peer assessment of questions)**	15
	b	**Evaluation Process (Documents related to Class Test, Assignments, Quiz, Seminar, Presentation etc)**	16
	c	**Attainment of COs**	17
16	**Student's Attendance Record**		18

4.3 Assessment Process

4.3.1 Part A]

4.3.1.1 Assessment Tools and Rubrics

The Institute is affiliated to Savitribai Phule Pune University (SPPU) and accordingly the assessment process is comprised of the tools as shown in Table below based on which measurement of the course outcomes (COs) is done.

Sr. No.	Assessment Tools	Assessment	Frequency
1	ENDSEM University Examination	70 Marks	Once in a semester
2	University Oral/Practical Examination	25/50 Marks	Once in a semester
4	INSEM Examination	30 Marks	Once in a semester
5	Term Work	25/50 Marks	Once in a semester
6	Class Test and Assignment	30 Marks	Once in a semester

Sample Class Test Paper

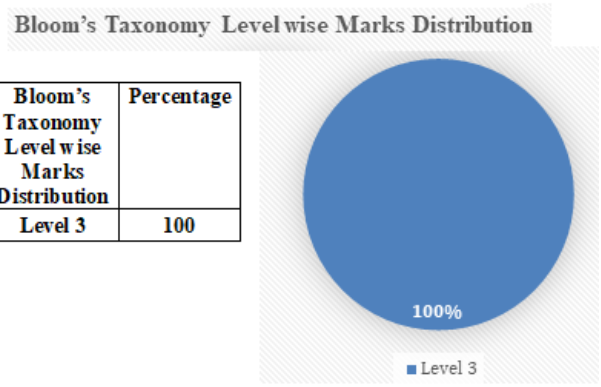
DEPARTMENT OF MECHANICAL ENGINEERING
B.E. Mechanical
CLASS TEST: Dynamics of Machinery (2019 Pattern) A. Y.: 2023-24

Date:28/8/2023
Time: 1:00 hrs. *Max. Marks :30*

Instructions to the Candidates:

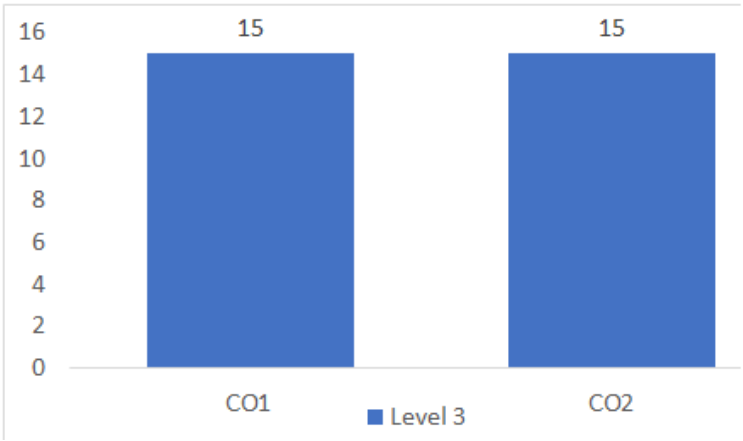
1) *Answer Q.1 or Q. 2, Q. 3 or Q. 4*
2) *Neat diagrams must be drawn wherever necessary*

Q. No.	Question Statement	Marks	CO	BL	PI
CO1: APPLY balancing technique for static and dynamic balancing of multi cylinder inline and radial engines					
Q. 1 a)	**Demonstrate** primary balancing of three-cylinder two stroke inline engine.	6	CO1	**L3**	**2.1.3**
Q. 1 b)	Four masses A, B, C and D carried out by a rotating shaft at radii 80 mm, 100 mm, 160 mm and 120 mm respectively are completely balanced. Masses B, C and D are 8 kg, 4 kg and 3 kg respectively. **Determine** the mass A and the relative angular positions of the four masses if the planes are spaced 500 mm apart	9	CO1	**L3**	**2.1.3**
OR					
Q. 2 a)	**Illustrate** the primary balancing analysis of three-cylinder two stroke inline engine with proportionate sketches of primary force and primary couple polygon.	9	CO1	**L3**	**2.1.2**
Q. 2 b)	**Demonstrate** the primary and secondary balancing of two-cylinder inline engine.	6	CO1	**L3**	**2.1.3**
CO2: ANALYZE the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles					
Q. 3 a)	**Determine** from the first principles an expression for the gyroscopic couple.	6	CO2	**L3**	**2.1.3**
Q. 3 b)	The rotor of a turbojet engine has a mass of 100 kg and a radius of gyration 250 mm. The speed of the engine is 10000 rpm in the clockwise direction when viewed from the front of the aeroplane. The aeroplane while flying at 1000 km/hr turns with a radius of 2 km to the left. **Calculate** the gyroscopic moment exerted by the rotor on the plane.	9	CO2	**L3**	**2.2.3**
OR					
Q. 4 a)	**Examine** the effect of gyroscopic couple on two-wheeler.	7	CO2	**L3**	**2.1.3**
Q. 4 b)	**Examine** the effect of gyroscopic couple on four-wheeler.	8	CO2	**L3**	**2.1.3**



Bloom's Taxonomy Level wise Marks Distribution	Percentage
Level 3	100

Course Outcome wise Marks Distribution	CO1	CO2
Level 3	15	15



BL-Bloom's Taxonomy Levels (1-Remembering, 2-Understanding, 3-Applying, 4-Analysing, 5-Evaluating, 6-Creating) CO-Course Outcomes PO-Program Outcomes, PI Code-Performance Indicator Code

Rubrics for Class Test

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Poor (1)	Score
Understanding of Concepts	Demonstrates clear and deep understanding of concepts.	Good understanding with minor mistakes.	Basic understanding but some confusion.	Limited understanding with major errors.	No understanding, mostly incorrect answers.	
Problem-Solving Ability	Uses the right method, solves correctly, and explains clearly.	Uses the right method but makes small mistakes.	Tries to solve but makes some mistakes.	Tries to solve but has many mistakes.	Doesn't try or completely wrong.	

Accuracy of Answers	All answers are correct and well-explained.	Mostly correct with a few mistakes.	Some correct answers, but many errors.	Many incorrect answers, lacks clarity.	Mostly incorrect or blank responses.	
Clarity & Presentation	Answers are well-structured and clearly written.	Mostly clear, with some minor issues.	Understandable but could be clearer.	Poorly written, hard to follow.	Very unclear, messy, or illegible.	
Use of Diagrams/Illustrations (if applicable)	Correct use of terms, formulas, and calculations.	Mostly correct usage with minor errors.	Some mistakes in terminology or formulas.	Frequent errors in terms and calculations.	Incorrect use of terms and formulas.	
Completion & Effort	All questions attempted with great effort.	Most questions attempted with good effort.	Some questions left blank, moderate effort.	Many questions left blank, minimal effort.	Very little effort, mostly unanswered.	
Sign			**Remark/Grade: / 30**			

Laboratory Continuous Assessment Rubrics

DIMENSION	**SCALE**					**SCORE**
	1	**2**	**3**	**4**	**5**	
Regularity and punctuality	Did not Perform, submitted in time	Performed and submitted later than scheduled date	Performed	Performed	Performed and submitted as per schedule	
Understanding and preparation for Objective	Neither shows any understanding of the objective nor can relate it to theory.	States the objective very vaguely	Can only state the objective but Shows poor understanding	Understands objective but cannot place it in context of	Understands objective and can relate it	
Participation in performance and conduction of experiment	Does not participate	Performs the experiment only with the help from supervisor/ or confused and untidy.	Performs the experiment with some supervisory help; but forgets some crucial reading and is confused and untidy.	Performs experiment	Performs experiment his/her own without supervisory help; records clean and tidy.	

Post experiment skills	Cannot follow the procedure and do any work	Follows procedure half-heartedly	Follows right procedure; but cannot analyze data and interpret it	Follows right procedure and can analyze data and interpret it	Follows right procedure; can analyze data and interpret it with justification	
Sign			**Remark/Grade: / 20**			

Rubrics for Assignments

Dimension	**SCALE**			
	Substantial (5)	**Moderate (4)**	**Slight (3)**	**Score**
Regularity and punctuality	Submitted as per schedule.	Submitted later than scheduled date with permission.	Submitted one week late.	
Reasoning and Analysis	Clear and accurate answers; insightful and specific.	Some answers correctly justified; an important reason(s) overlooked.	Irrelevant incomplete & answers.	
Grammar & Language	No grammar or spelling mistakes, well-written	Few minor errors, good readability.	Noticeable errors, but understandable.	
Focus on Topic	Answers address the questions clearly and fully, showing higher uses of course vocabulary.	Answer is not as detailed and/or concise as needed; use limited course vocabulary.	Very few of the answers relates to the assigned subject questions.	
Presentation & Neatness	Well-formatted, neat, and visually appealing.	Mostly neat with some formatting issues.	Untidy, lacks proper formatting	
Organization	Use of correct grammar, spelling, and punctuation; well organized; one idea follows another in a logical sequence with clear transitions;	Enough errors to distract the readers; organization problems; questions not stated before answers; and/or format difficult to navigate.	Numerous errors, hard to read; questions are not stated before answers; format details are not adhered to.	

	questions stated before answers; format easy to navigate.			
Sign		**Remark/Grade: /30**		

Rubrics for Internship

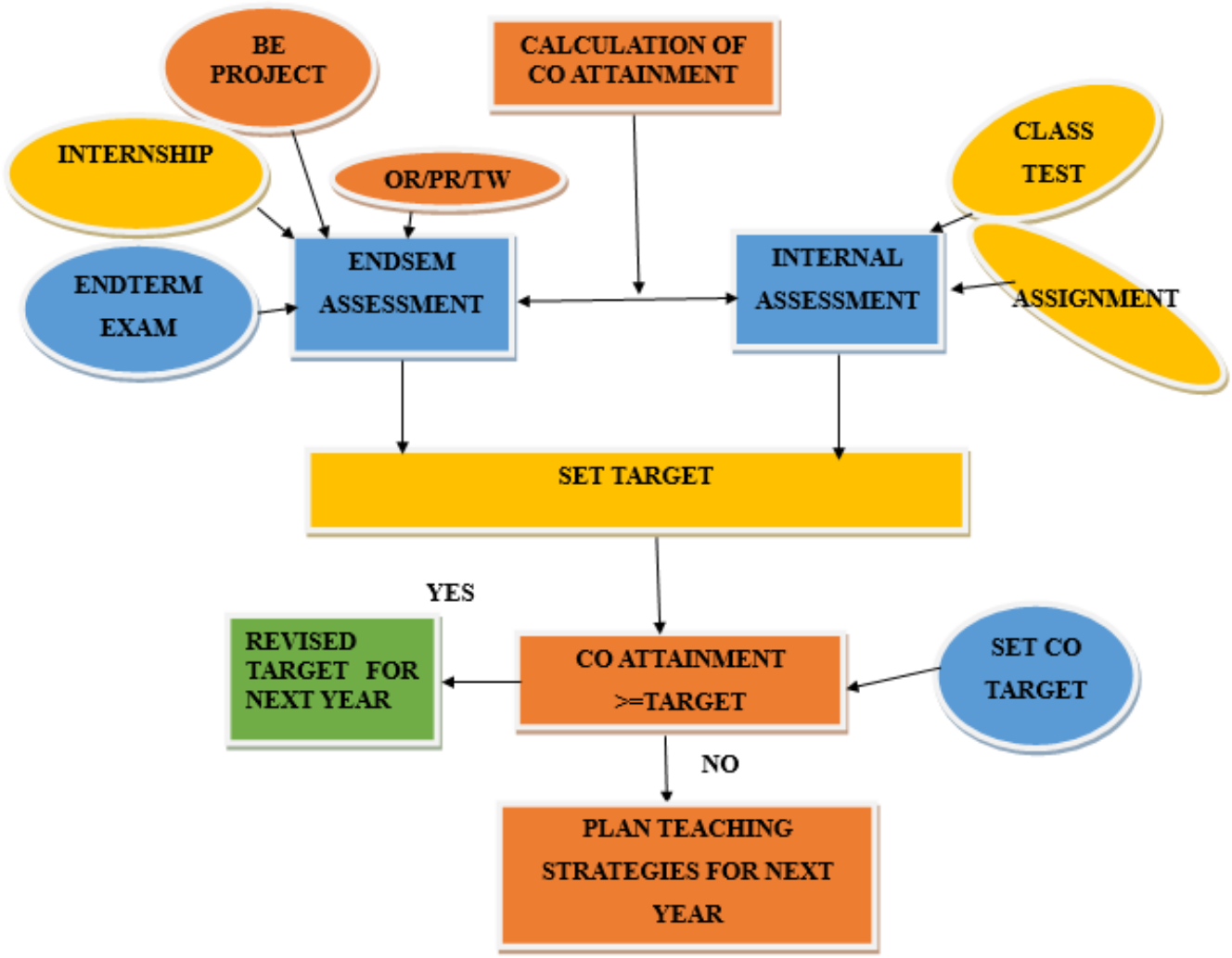
Sr. No.	Exam Seat No.	Name of Student	Signature of Student	Presentation Skills (20)	Technical Question & Answers (60)	Report (20)	Total marks (100)
1							
2							
3							

Rubrics for Project

EP	Group Evaluation	Excellent (8-10)	Good (5- 7)	Average (≤ 4)	Student Score			
					S-1	S-2	S-3	S-4
1	**Implementation of Objectives and project plan**	**Project objectives are fully achieved** with well-documented implementation	**Project objectives are mostly achieved** with some documented implementation	**Project objectives are partially achieved** with weak implementation				

`2	**Experimental/simulation work (CAD/CAM/CAE) Validation & Testing**	**Comprehensive Experimental validation** and testing with strong justification of results.	**Some validation** and testing performed but lacks depth.	**Irrelevant Experimental /Simulation work**. Little or no validation and testing.				
3	**Innovation & Creativity**	**High level of innovation** in methodology, approach, or technology used.	**Moderate level of innovation** with some novel aspects.	**Minimal or no innovation** in project work**.**				
4	**Use of Modern Tools**	**Appropriate modern tools** used for collection and analysis of data.	**Few Modern tools** used for collection and analysis of data.	**No Modern tools used for collection** and analysis of data.				
5	**Team Contribution & Collaboration** (Individual marks for each student)	**All members contribute actively** with excellent teamwork and coordination.	**Some members contribute more than others**; moderate teamwork.	**Unequal contribution with poor teamwork** and coordination.				
6	**Project soft copy report (as per SPPU syllabus guidelines)**	Information in project report is in logical sequence with diagrams, tables, results and discussion. **The report is complete and in proper format.**	Information in project report is in logical sequence with diagrams, tables, results and discussion. **The report is partially complete and in proper format**.	There is no Information about the project with no results and discussion. **The report is incomplete and not in proper format**.				
Total								

4.3.1.2 CO attainment calculation process



A detailed description of the various tools such as external and internal for attainment of course outcomes is given below:

A. External assessment tools: Since the institute is affiliated to Savitribai Phule Pune University (SPPU), external assessment tools are based on examinations conducted by SPPU.

a. **Theory examination** is conducted at the mid of semester (INSEM Examination) and at the end of semester (ENDSEM examination). INSEM examination is based on first two units addressing first two course outcomes (CO1 and CO2) and is of 30 Marks. ENDSEM examination addresses remaining four COs (CO3, CO4, CO5, CO6) for that course and is of 70 Marks.

b. Practical/Oral examination: Practical/Oral examination is based on the contents mentioned in the syllabus for the respective course. The type of CO addressed during this examination varies from student to student. In totality, all COs are addressed.

c. Term work: Term work marks are given based on the contents mentioned in the syllabus for the respective course. Term work addresses all COs.

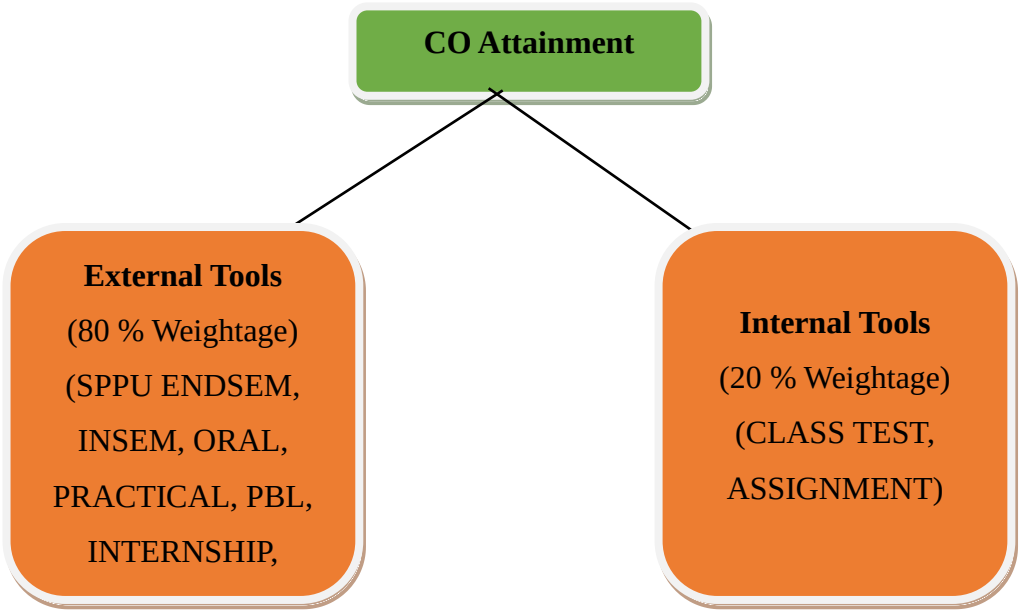
B. Internal assessment tools: Internal assessment tools include internal class test and assignment.

For project-based learning (PBL), Internship and projects, assessment is based on reviews and presentation.

4.3.2 Part B]

4.3.2.1 Rules for calculating Attainment level (direct) through SPPU Examination, internal assessment tools

For CO direct attainment, University exam heads such as INSEM, ENDSEM, Practical, Oral and Term Work as per the evaluation scheme defined for the course by SPPU are considered as external tools and Class test, assignment etc. are treated as internal tools. While measuring direct CO attainment, weightage to external tools is 80 % and 20 % weightage is given to internal tools (refer Fig.). These external and internal tools are treated as direct assessment tools.



The levels for CO attainment are defined in terms of percentage of students scoring with respect to the set target marks. Target marks for the course during the academic year is decided based on the all assessment tools for the same course in earlier year. This is done by taking average of marks.

Total CO Attainment = 0.8(External Assessment) + 0.2 (Internal Assessment)

4.3.2.2. Rule for CO (Direct and Indirect) attainment level

Level of Attainment	Rule for Attainment	Assessment Tool	Weightage (%)
3	80% and more students having more than target marks	**Direct (External/Internal)**	100
2	70% to 79% students having more than target marks		
1	60% to 69% students having more than target marks		
0	less than 60% students having target marks		

4.3.3 Part C]

4.3.3.1 Attainment of Course Outcomes

As an example of CO attainment methodology using Direct (External and Internal), following section describes the procedure.

A step-by-step procedure in measurement of CO direct attainment is outlined below:

- The database of marks for a course with external and internal tools is prepared in MS Excel
- Set target based on average of previous years' marks
- As per the rules of the co attainment, get the attainment levels for each assessment tool
- These attainment levels are diffused for CO1 to CO6

- Finally, as per the decided weightages, CO attainment calculations are done CO wise and averaged to get one numeric value at course level as direct CO attainment for that course

4.3.3.2 Database of marks (external and internal tools) in excel for CO attainment for sample course

	CO Attainment Sheet						
	Name of Course: Design of Trans. Sys.		A. Y. 2022-23				
	Name of Faculty: Dr. P. G. Kulkarni						
	Target	57					
		External Assessment				Internal Assessment	
Exam Seat No.	Student Name	Insem	Endsem	PP	PR/OR	T1	A1
		30	70	100	25	30	30
T190070801	TAMBOLI AMAAN RAJAK	15	51	66	18	27	24
T190070802	ABHIRAJ SACHIN YADAV	14	46	60	20	23	26
T190070803	ADHAU SANIDHYA ATUL	11	39	50	19	27	25
T190070804	ADHE VEDANT PRASHANT	14	55	69	21	28	26
T190070805	ADITI KAILAS JEBALE	19	37	56	19	27	25
T190070806	ADITYA ARUNKUMAR KAPASE	24	46	70	20	23	24
T190070807	ADSUL PRATHMESH KISAN	13	45	58	18	22	25
T190070808	ANIKET SANJAY KATE	16	49	65	17	25	24
T190070809	ANURAG SUNIL NAIK	16	38	54	19	23	26
T190070810	ATHARVA AJIT KUNDAP	24	46	70	20	23	27
	Sum of marks	2602	5780	8382	2911	3788	3799
	Target Attainment level for individual tool	17	40	57	14	17	17
	No. of students securing marks above target	73	84		141	152	153
	Actual % Attainment	48	55		93	100	101
	Level of attainment	0	0		3	3	3

4.3.3.3 CO (direct) attainment for sample course

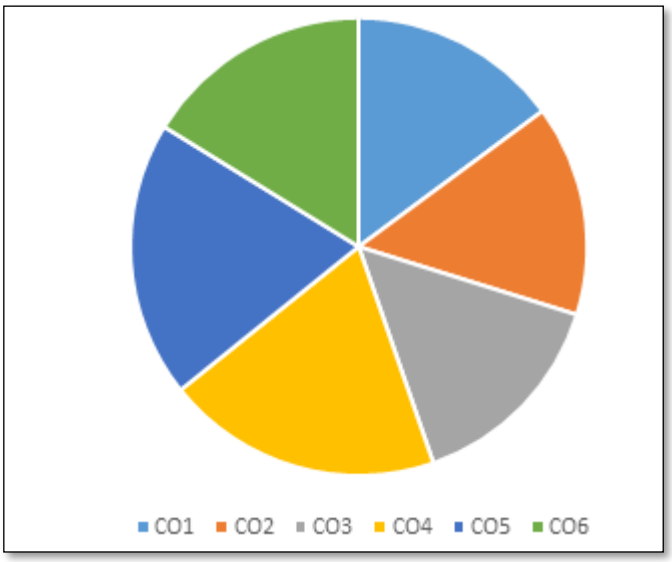
CO Attainment Table						
Academic Year: 2022-23 Term II				Name of Faculty: Dr. P. G. Kulkarni		
Course: DTS				Target (based on earlier year): 57		
External	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
SPPU Insem	**0**	**0**				
SPPU Endsem			**0**	**0**	**0**	**0**
SPPU OR/PR	**3**	**3**	**3**	**3**	**3**	**0**

Internal						
Test	3	3				
Assignment 1			3	3	3	3
Average of SPPU	1.50	1.50	1.50	1.50	1.50	0.00
Average of Internal	3.00	3.00	3.00	3.00	3.00	3.00
Attainment level as per rules set	1.80	1.80	1.80	1.80	1.80	1.8
Course Direct Attainment Level (D)	1.8					

Taking in to account CO wise direct and indirect attainment, total attainment is measured by assigning appropriate weightages as discussed in earlier section. The same is shown in Table below. Graphical representation of CO attainment for sample course is shown in pie chart.

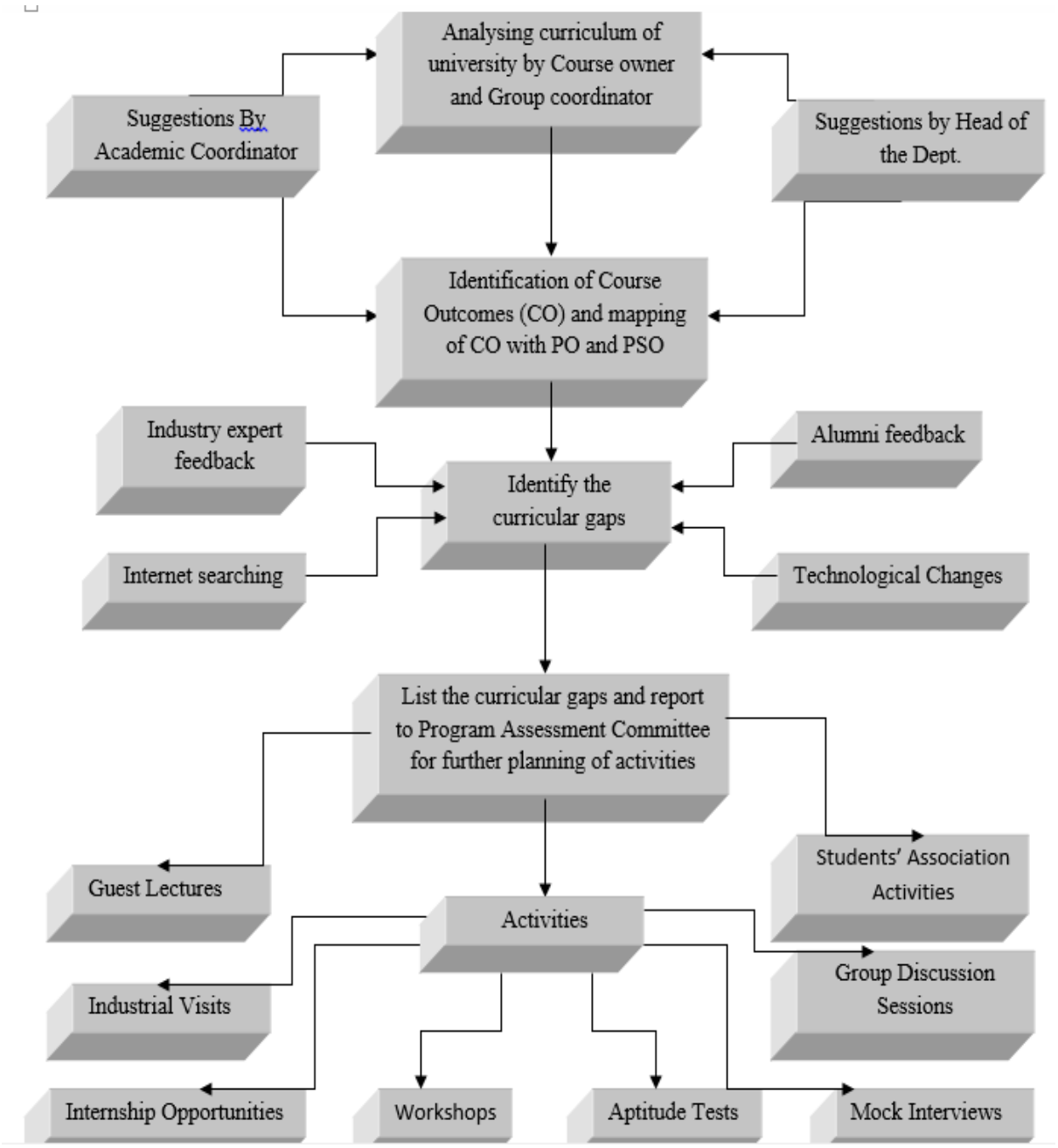
Total CO attainment for sample course:

COs	CO1	CO2	CO3	CO4	CO5	CO6
CO Attainment	1.8	1.8	1.8	1.8	1.8	1.8



Similar procedure is followed for all the courses in the program and the values of Total CO attainment along with target marks are tabulated in Table.

5. Curriculum Gap identification Process

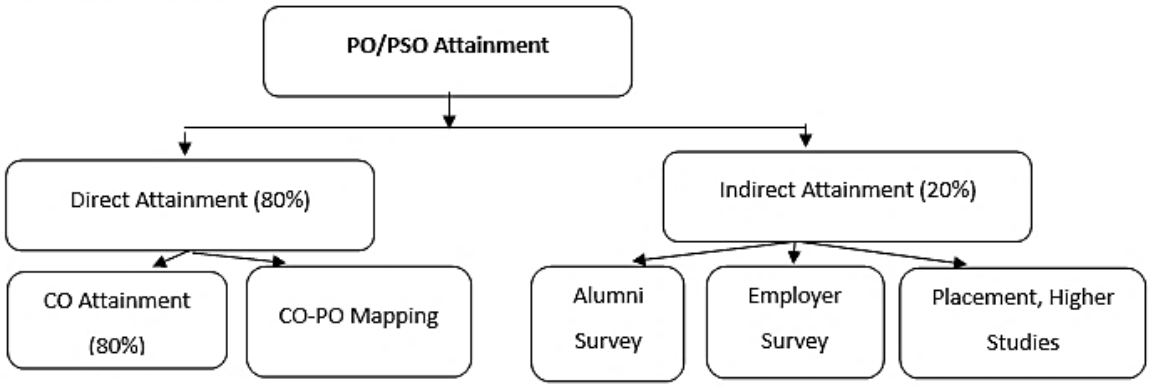


6. Assessment tools and processes used for measuring the attainment of each of the Program Outcomes and Program Specific Outcomes

6.1 Assessment Tools/Processes used:

Assessment tools for measuring the program outcomes and program specific outcomes are classified into two categories:

1. Direct assessment tools
2. Indirect assessment tools



6.2 Assessment tools for PO direct attainment

External assessment i.e. University Examination (Theory, Oral, Term work, Practical, INSEM examination)

- Internal assessment (class test, assignment)
- Direct PO attainment is based on Total CO attainment and CO-PO matrix.

PO ATTAINMENT:

Assessment tools for PO Direct attainment

Sr. No.	Assessment Tools	Frequency
1	University Examination (Theory, Oral, Term work, Practical, Online, INSEM examination)	Once in a semester
2	Internal assessment (class test, assignment)	Once in a semester

Example of direct attainment of program outcomes from CO attainment

CO-PO mapping for a course:

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		1				2				2	0	0
CO2	3	1		1	3			2		3		2	1	1
CO3	3	1						2				2	1	1
CO4	3	1		1								2	0	0
CO5	3	1		1	3			3	2	3		2	0	0
CO6	3	1	2		1	2	2					2	1	0
Avg.	3	1	2	1	2.3	2	2	2.2	2	3		2	1	1

Mapping is based on Performance Indicators as shown for sample PO1.

	PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.		
	Competency		**Indicators**
1.1	Demonstrate competence in mathematical modelling	1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
		1.1.2	Apply advanced mathematical techniques to model and solve mechanical engineering problems
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural sciences to an engineering problem
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply fundamental engineering concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply Mechanical engineering concepts to solve engineering problems.

Assuming that the CO attainment for above considered course is 1.7, the PO direct attainment calculations are made as explained below:
CO total attainment is 1.7 and mapping with PO1 is 3. Hence PO1 attainment is 1.7 X 3/3 = 1.7
where numerator is mapping of CO1 with PO1 and denominator is maximum possible level of attainment.
Total calculations are shown below:

PO Direct	1.7	0.6	1.1	0.6	1.3	1.1	1.1	1.3	1.1	1.7		1.1	0.6	0.6

6.3 Assessment tools for PO indirect attainment

Indirect PO attainment is based on various tools such as Alumni Survey / Student Exit Survey, Placement, Higher Studies, Entrepreneurship and Co-curricular Activities. These are explained in Table below along with the frequency.

Assessment tools for PO indirect attainment

Sr. No.	Assessment Tools	Frequency
1	Alumni Survey	Once in a year
2	Employer Survey	Once in a year
2	Placement, Higher Studies, Entrepreneurship	Once in a year

The rules for PO indirect attainment levels for Alumni Survey and Placement, Higher Studies and Entrepreneurship respectively are shown below.

6.4 Rule for attainment levels for Alumni Survey

More than 80 % score	Level 3
61 to 80 % score	Level 2
46 to 60 % score	Level 1
Less than 45 % score	Level 0

6.5 Rule for attainment levels for Placement, Higher Studies and Entrepreneurship

No of students Placed/Higher studies/Entrepreneurs more than 65 %	level 3
No of students Placed/Higher studies/Entrepreneurs 51 -65%	level 2
No of students Placed/Higher studies/Entrepreneurs 35 - 50%	level 1
No of students Placed/Higher studies/Entrepreneurs less than 35 %	level 0

Finally, the weightages assigned for direct and indirect tools, total PO attainment is calculated at program level.

7. Target Attainment Level of Program Outcomes (PO's) and Program Specific Outcomes (PSO's)

7.1 Setting PO Target (Sample basis from PO1 to PO5)

Code	Name of Course	PO1	PO2	PO3	PO4	PO5
C101	Engineering Mathematics-I	2.00	1.00			
C102	Engineering Physics	1.83	1.00			
C103	Systems in Mechanical Engineering	1.83	1.50	1.25		2.00
C104	Basic Electrical Engineering	2.17	1.50	2.00		1.00
C105	Programming and Problem Solving	1.50	1.00			1.00
C106	Workshop	3.00		1.00		2.00
C107	Audit Course - Environmental Studies 1		1.00	2.00		
C108	Engineering Mathematics-II	2.00	1.00	0.00	0.00	0.00
C109	Engineering Chemistry	1.00				
C110	Basic Electronics Engineering	2.00	1.00	1.50	2.00	1.00
C111	Engineering Mechanics	2.00				
C112	Engineering Graphics	1.33				1.20
C113	Project Based Learning	3.00	1.50	1.00	2.00	1.50
C114	Audit Course 2 - Environment Studies 2	1.00	1.25	1.75		
C115	Audit Course 2 - Physical Education-Exercise and Field Activities					
C201	Solid Mechanics	3.00	3.00			
C202	Solid Modelling and Drafting	1.50		1.00	1.00	1.00
C203	Engineering Thermodynamics	2.00	1.50	2.00	1.00	1.00
C204	Engineering Materials and Metallurgy	2.00				2.00
C205	Electrical and Electronics Engineering	1.50				
C206	Geometric Dimensioning and Tolerancing Lab	3.00	2.00			
C207	Engineering Mathematics - III	3.00	2.00			
C208	Kinematics of Machinery	3.00	2.00			
C209	Applied Thermodynamics	2.00	1.50	1.00	1.00	1.00
C210	Fluid Mechanics	2.67	1.00			1.00
C211	Manufacturing Processes	2.67	2.00	1.00	1.00	
C212	Machine Shop	1.25	1.67	1.00		
C213	Project Based Learning - II	2.00	2.00			1.00
C301	Numerical & Statistical Methods	2.67	2.67	1.00	2.00	2.67
C302	Heat & Mass Transfer	2.67	1.00			1.00

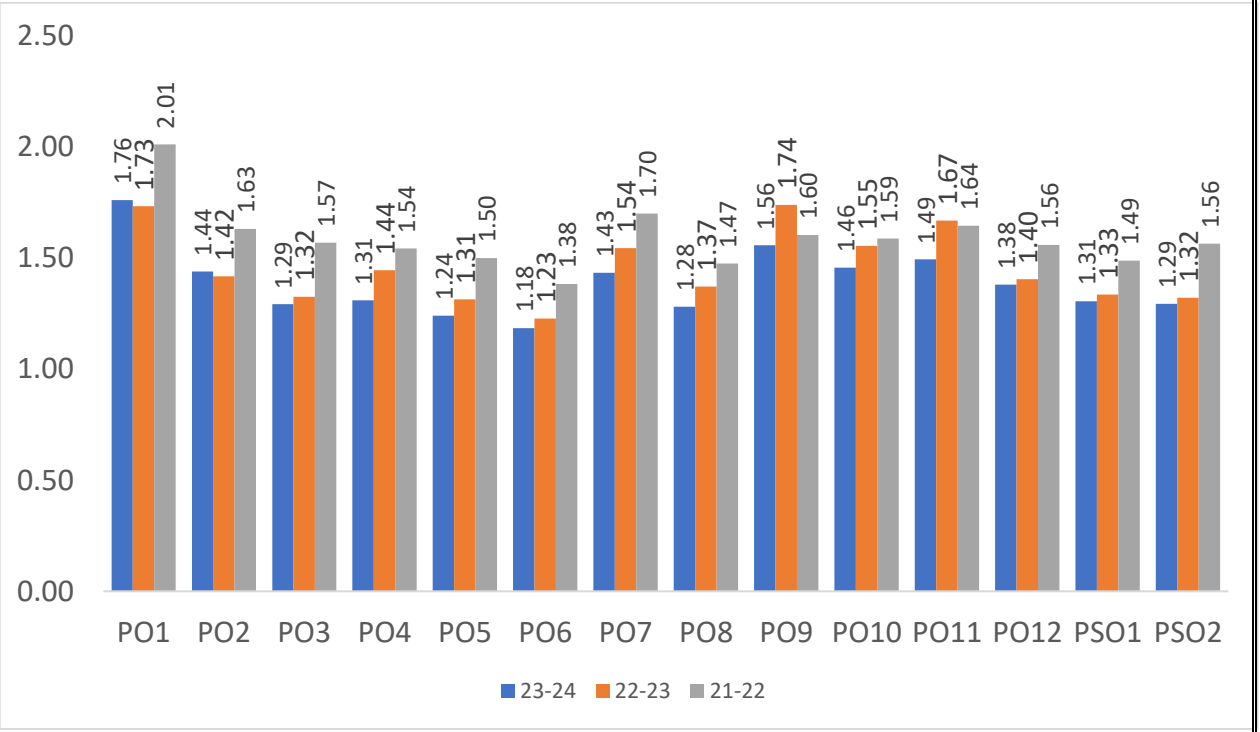
C303	Design of Machine Elements	2.00		2.00		1.00
C304	Mechatronics	1.67	1.20		1.00	
C305A	Elective 1 - Advanced Forming & Joining Processes	3.00	1.00	1.00		1.50
C305B	Elective 1 - Machining Science & Technology	2.60	1.00	1.00	1.67	1.00
C306	Digital Manufacturing Laboratory	2.00	1.00			
C307	Skill Development	1.50	1.50			1.00
C308	Artificial Intelligence &Machine Learning	1.00	1.00	1.00	1.00	2.00
C309	Computer Aided Engineering	1.60	1.00			1.00
C310	Design of Transmission Systems	3.00	1.00	2.00	1.00	2.33
C311A	Composite Materials	1.20	1.83	1.50	2.00	1.00
C312	Measurement Laboratory	2.00	1.33			
C313	Fluid Power &Control Laboratory	2.00	2.00	1.50	2.67	2.00
C314	Internship/ Mini Project	1.50			1.25	1.50
C401	Heating Ventilation Air-Conditioning and Refrigeration	2.50	2.00	2.00		1.00
C402	Dynamics of Machinery	3.00	1.00	2.00	1.00	2.00
C403	Turbomachinery	3.00	2.00		1.00	
C404D	Industrial Engineering	2.33	1.50	1.00	1.25	
C404E	Internet of Things	1.20	1.00	1.00		1.00
C405A	Product Design and Development	2.50	1.80	2.00	1.00	
C405D	Operations Research	2.50	1.67	1.00	1.17	
C406	Data Analytics Laboratory	2.00	2.00	1.00	2.20	
C407	Project (Stage - I)	1.67	2.00	1.75	1.75	1.00
C408	Computer Integrated Manufacturing	2.83	1.33	2.00	2.00	1.50
C409	Energy Engineering	2.00			2.00	2.00
C410A	Quality and Reliability Engineering	2.33	1.50	1.00	1.50	
C411C	Automation and Robotics	2.67	1.00		2.33	1.00
C411D	Industrial Psychology and Organizational Behaviour	1.00	1.00		1.00	1.00
C412	Mechanical Systems Analysis Laboratory	1.75	1.25	1.00	1.50	1.67
C413	Project (Stage - II)	2.67	2.75	2.25	2.25	1.00
	PO wise Target	**2.12**	**1.49**	**1.38**	**1.47**	**1.33**

7.2 PO Target Vs PO Attained (2022-23)

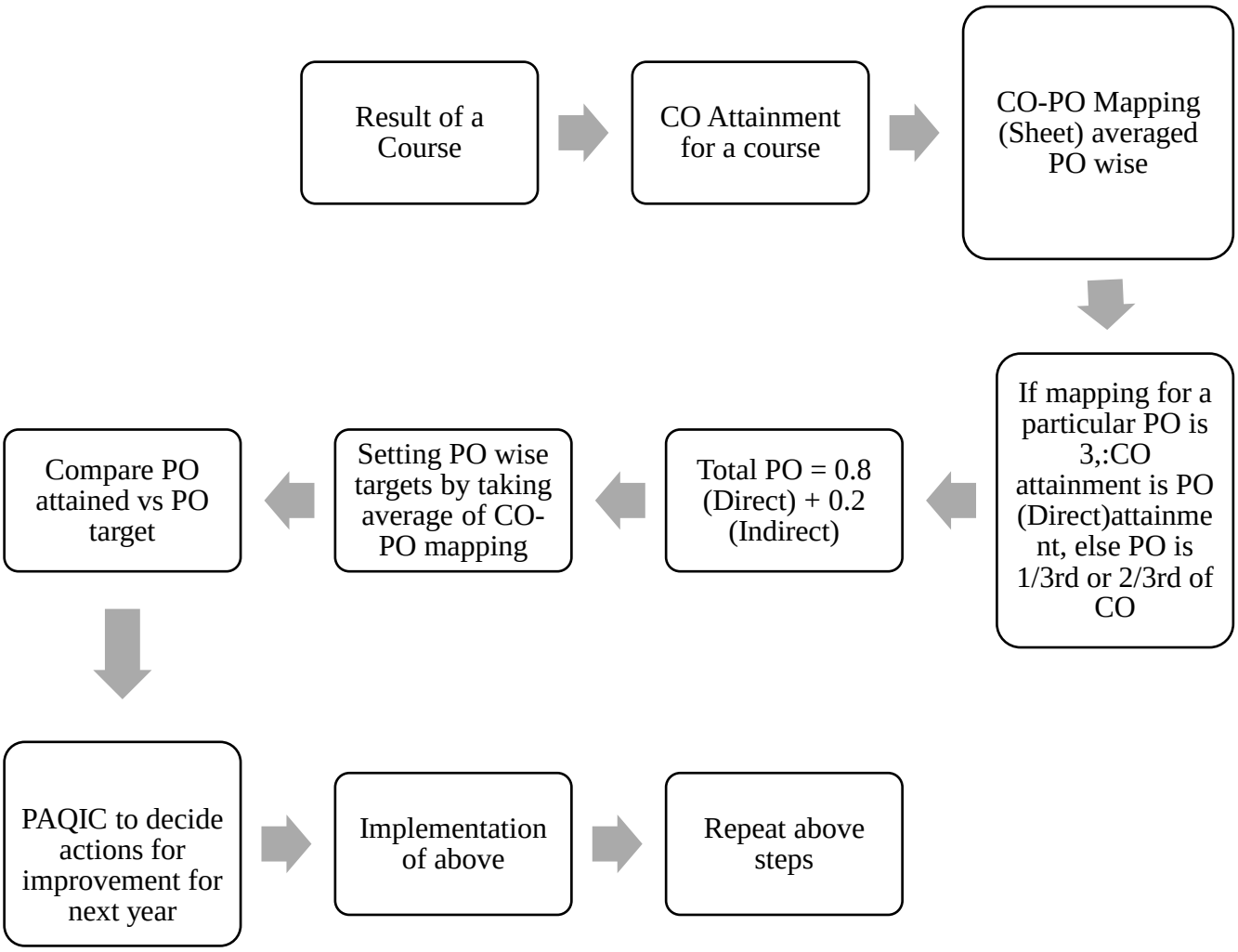
POs	PO Target	PO (D)	PO (I)	PO Total	% PO
PO1	**2.12**	1.42	3.0	**1.73**	**81.90**
PO2	**1.49**	1.02	3.0	**1.42**	**94.85**
PO3	**1.38**	0.99	2.7	**1.32**	**96.09**
PO4	**1.47**	1.14	2.7	**1.44**	**98.52**
PO5	**1.34**	0.97	2.7	**1.31**	**98.05**

PO6	**1.18**	0.87	2.7	**1.23**	**103.73**
PO7	**1.52**	1.18	3.0	**1.54**	**101.55**
PO8	**1.25**	1.05	2.7	**1.37**	**109.60**
PO9	**1.67**	1.42	3.0	**1.74**	**104.41**
PO10	**1.66**	1.28	2.7	**1.55**	**93.71**
PO11	**1.48**	1.34	3.0	**1.67**	**112.59**
PO12	**1.54**	1.09	2.7	**1.40**	**91.42**
PSO1	**1.51**	1.08	2.3	**1.33**	**88.63**
PSO2	**1.47**	0.98	2.7	**1.32**	**89.72**

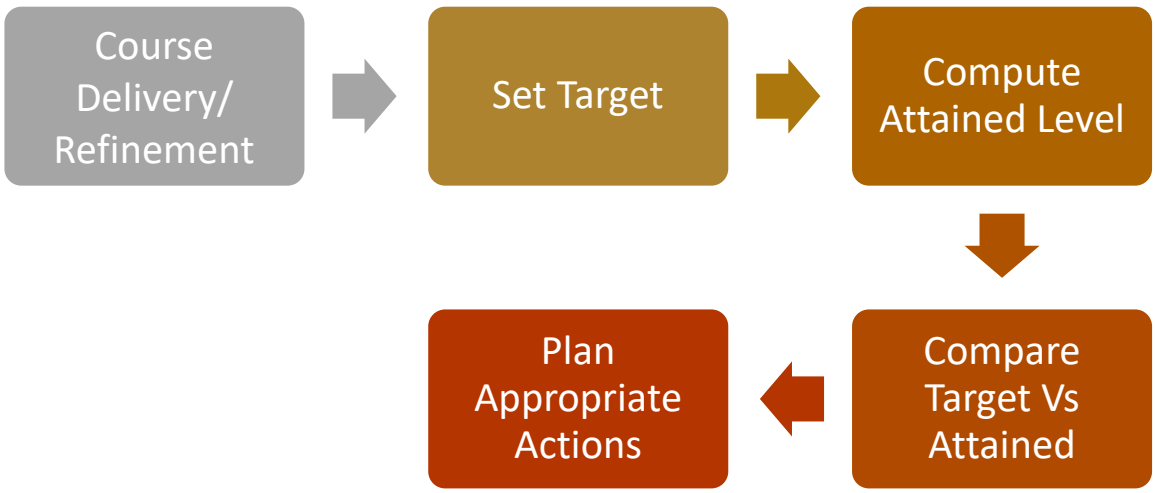
7.3 Overall PO/PSO attainment for A. Y. 2023-24, 2022-23, 2021-22



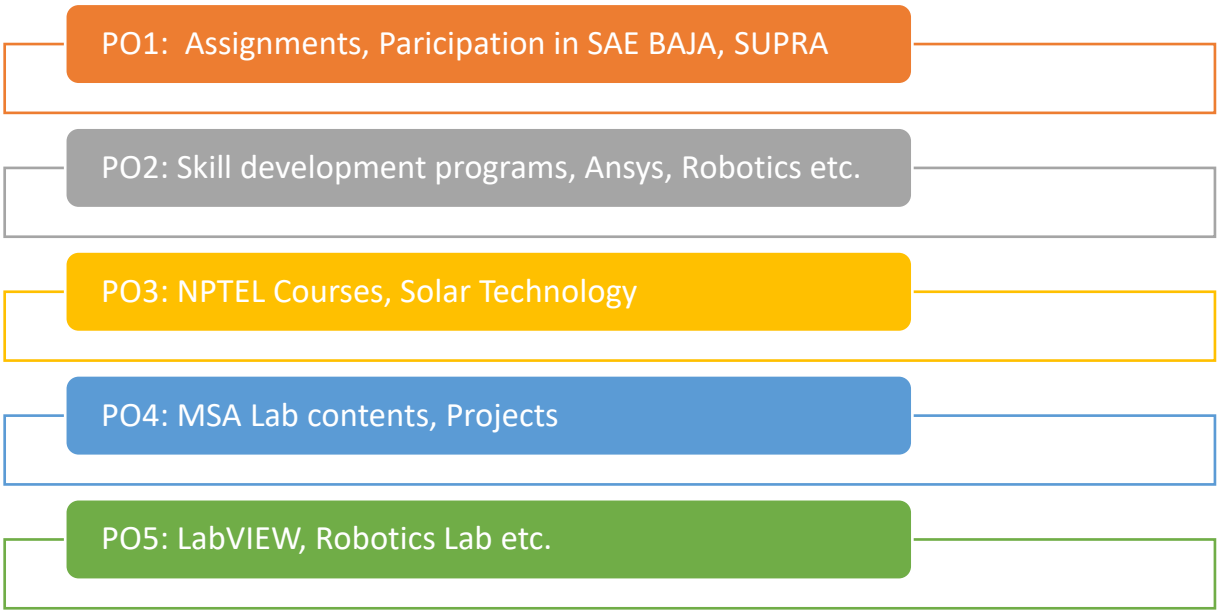
7.4 Continuous Improvement Based On PO/PSO Attainment



Based on the result analysis, CO attainment calculations are done and as per the methodology discussed earlier PO attainment calculations are done. Year wise PO targets are set as per the established guidelines approved by PAQIC. Comparison is made between the target and attained values of PO and gap analysis are done. Based on this, the actions for improvement are planned.

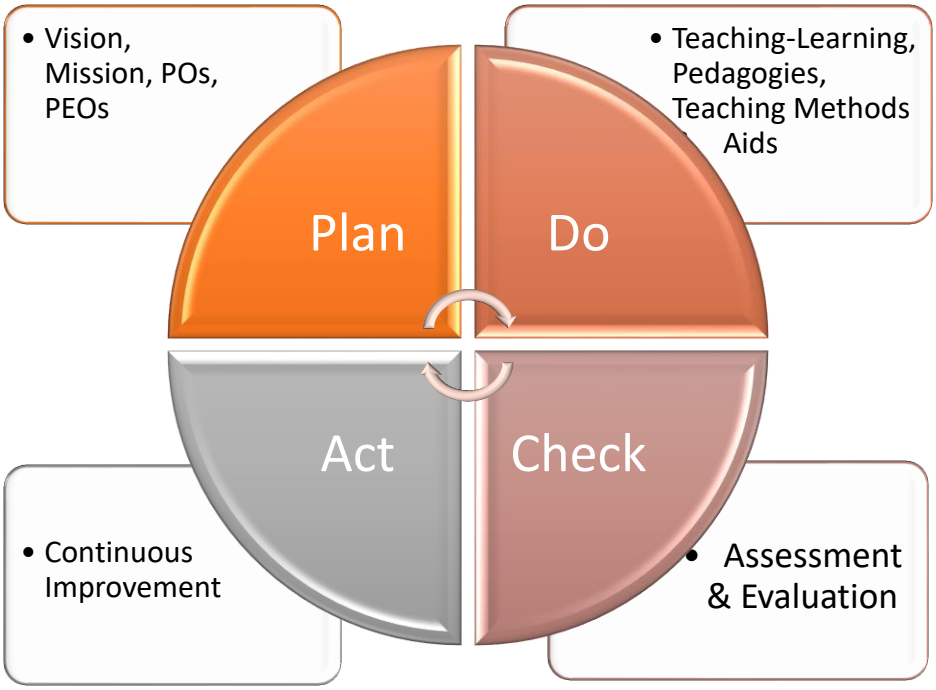


7.5 Sample Continuous Improvement Analysis (PO1 to PO5)



7.6 Steps To Implement Outcome Based Education In Higher Education

Based on the methodology discussed for CO and PO attainment, the steps for implementing OBE are outlined below.



8. Conclusion:

- Outcome-Based Education (OBE) focuses on student learning and has become increasingly favoured in higher education for enhancing student performance and institutional efficiency.
- The adoption of OBE presents certain challenges; however, effective tools and strategies can facilitate a smooth transition.
- Institutions can achieve successful implementation of OBE by leveraging appropriate resources and methodologies.

9. References

1. General Manual for Accreditation, National Board of Accreditation (https://www.nbaind.org/)
2. Dr. V. V. Rao, "Outcome Based Education and Accreditation" VRV publications

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4. Model Question Papers For Undergraduate Programs (https://www.aicte-india.org/sites/default/files/MQP.pdf)

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