D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY

(Approved by AICTE, New Delhi, Recognized by Govt. of Maharashtra
& Affiliated to Shivaji University, Kolhapur)

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

Outcome Based Education

(OBE) Manual

(w.e.f. A.Y.: 2024-2025)

Draft-II

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Preface

This manual is a reference to help faculty members and stakeholders to understand the Outcome Based Education (OBE) system implemented at D.Y. Patil College of Engineering and Technology (DYPCET) since 2014. This manual provides a detailed description of Outcome Based Education implementation at all the four stages of educational process including curriculum design, teaching and learning process, assessment & evaluation and continuous quality improvement. Also, it provides suitable guidelines for the faculty members to develop the course plan, assessment plan etc., in the process to measure the outcome of the students during their course of study and also after their graduation.

OBE manual draft history

Sr. No	Draft No	Year of Release
01	Draft No-1	A.Y.: 2020-21
02	Draft No-2	A.Y.: 2024-25

Abbreviations

DYPCET	D. Y. Patil College of Engineering & Technology
NBA	National Board of Accreditation
NAAC	National Assessment and Accreditation Council
GA	Graduates Attributes
PI	Performance Indicators
WK	Washington Accord's Knowledge Profile
OBE	Outcome Based Education
BTL	Bloom's Taxonomy Level
LOT	Lower Order of Thinking
HOT	Higher Order of Thinking
PEOs	Program Educational Objectives
PSOs	Program Specific Outcomes
POs	Program Outcomes
COs	Course Outcomes
HoD	Head of the Department
PC	Program Coordinator
A.Y.	Academic Year
IQAC	Internal Quality Assurance Cell
BoS	Board of Studies
PAQIC	Program Assessment and Quality Improvement Committee
CE	Course Exit Survey
ISE	In Semester Examination
MSE	Mid Semester Examination
ESE	End Semester Examination
CGPA	Cumulative Grade Point Average

1. About the Institute

D. Y. Patil College of Engineering & Technology (DYPCET), Kasaba Bawada, Kolhapur is a self-financing **Autonomous Institute** established in the year 1984 under the visionary leadership of **Padmashree Dr. D. Y. Patil**, Former Governor of Tripura, Bihar and West Bengal. UGC, New Delhi and Shivaji University, Kolhapur has conferred Autonomous status to the Institute in 2020. The Institution is approved by All India Council for Technical Education (AICTE), New Delhi, Government of Maharashtra and affiliated to Shivaji University, Kolhapur. The Institute is accredited by **National Assessment and Accreditation Council (NAAC)**, Bangalore with **'A' grade (CGPA- 3.08)**. The Institute is offering quality technical education for the past 41 years. The Institute offers eight UG programmes and two PG programmes. Two departments of this Institution are recognized as research centres by Shivaji University, Kolhapur for promoting research culture in the Institute. Architecture department of the Institute is ranked amongst the top 13 Architecture Colleges in India by Outlook India and **ranked 21st by India Today in 2021. Three** UG programmes viz., B. Tech (Computer Science and Engineering), B. Tech. (Electronics & Telecommunication **Engineering**) and B. Tech. (Mechanical Engineering) is re-accredited by **National Board of Accreditation (NBA)**, New Delhi for a period of three years from 2022 to 2025.

Salient features of our institute are

- State of the art infrastructure
- WI-FI enabled campus
- Laboratories equipped with equipment with latest technologies
- 24 hours Internet connectivity
- Industry-backed NEP 2020 Curriculum
- MoUs with reputed Industries and Academic Institutes
- Excellent Placement Record
- 10000+ Worldwide Alumni network
- Annual Student Festivals and a vibrant Campus Life
- Bus facility available
- All Govt. Scholarships available to students
- Professional Chapters and Clubs
- Finishing School Trainings
- Rural & Social Internships, Industry visits and industry expert interaction
- Dedicated Professional Internship track of 6 months
- Capstone projects

2. Primary Definitions and Nomenclature

1. Outcome Based Education (OBE): OBE is a system where all the parts and aspects of education are focused on the outcomes of the course. The students take up courses with a certain goal of developing skills or gaining knowledge and they have to complete the goal by end of the course.

2. Higher Education Institutions are classified into two categories by NBA

Tier 1: Institutions consist of all IITs, NITs, Central Universities, State Universities and Autonomous Institutions. Tier - 1 institutions can also claim the benefits as per the Washington Accord.

Tier 2: Institutions consist of affiliated colleges of universities.

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

4. Mission: The mission statement(s) should define the broad purposes of the program or department, outline what it aims to achieve, describe the community it is designed to serve, and state the values and guiding principles that define its standards.

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

6.Graduates Attributes (GA)**: GA** are components that indicate a graduate's potential to acquire the competence required to practice at the appropriate professional level. GAs form a set of individually assessable outcomes of the program.

7.Program Educational Objectives (PEOs): PEOs are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Knowledge, Skill and Attitude are the three behavioral elements based on which PEOs are constructed.

8.Program Outcomes (POs): Program outcomes are statements that describe what students are expected to know and be able to do upon graduating from the program.

These relate to the skills, knowledge, analytical ability, attitude and behavior that students acquire through the program. And at present POs are 11 in number and they are identified by NBA and are applicable to all engineering programme.

9.Program Specific Outcomes (PSOs): Program Specific Outcomes are statements that describe what the graduates of a specific engineering program should be able to do. PSO can be 2 to 4 in number.

10.**Course Outcomes (COs):** Course Outcomes are specific and measurable statements that define the knowledge, skills, and attitudes learners will demonstrate by the completion of a course. It is a detailed description of what a student must be able to do at the conclusion of a course.

11.Course Objective: A course objective outlines the specific content and skills that the instructor intends to cover during the course. It is more focused than a broad course goal, yet more general than a student learning outcome. Course objectives emphasize what will be taught within the classroom or academic program.

12.Course Articulation Matrix (CAM): This is the mapping between Course Outcomes and the Programme Outcomes of a specific Course.

13.Course: Course **is** defined as a theory or a practical or a theory cum practical concepts studied in a semester. Example: Engineering Mathematics for Mechanical Engineering.

14. In Semester Examination (ISE): ISE means the examination to be held after completion of two units. ISE shall be based on student's performance in assignment, seminar, quizzes, viva-voce etc.

15.Mid Semester Examination (MSE): MSE means the examination to be held at the mid of semester for theory courses. MSE is based on 50% curriculum of a course.

16.End Semester Examinations (ESE): ESE means the examinations to be held at the end of each semester separately for theory & practical part on such dates as the University/College may determine.

17.Continuous Internal Assessment (CIA): Continuous Internal assessment is a form of educational examination that evaluates a student's progress throughout a prescribed course

18.Bloom's Taxonomy Level: 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.

Lower order Thinking (LoT): The lower-order thinking skills include Remembering, Understanding and Applying.

Higher order Thinking (HoT): refer to skills that go beyond memorizing information.

19.Direct Assessment Method :(Measurable in terms of marks and w. r. t. CO)

Direct measures of student learning require students to display their actual knowledge and skills (rather than report what they think their knowledge and skills are). Examples of direct assessment methods include ISE, MSE, ESE, presentations, and classroom assignments.

20.Indirect Assessment Method: (Non-measurable in terms of marks and w.r.t.CO)

Indirect assessment asks students to reflect on their learning rather than to demonstrate it. Examples include external reviewers, course end survey, student exit surveys, exit interviews, alumni surveys, employer surveys, etc.

21.Rubric: A scoring and instruction tool used to assess student performance using a task-specific range or set of criteria. To measure student performance against this pre-determined set of criteria, a rubric contains the essential criteria for the task and levels of performance (i.e., from poor to excellent) for each criterion.

22.Assessment: Assessment is one or more processes carried out by the department that identifies, collect, and prepare data to evaluate the achievement of PO and PSO.

23.Stakeholders

Internal Stakeholders

- Students
- Faculty & Staff Members
- Management

External Stakeholders

- Members of the Governing Body, Academic Council, BOS , etc
- Parents
- Industries
- Society
- Alumni

3. Outcome Based Education - OBE

3.1 Deficiencies in Traditional Education

- Traditional education provides students with a learning environment with little attention to whether or not students ever learn the material.
- Students are given grades and rankings compared to each other – students become exam-oriented or CGPA driven.
- Graduates are not completely prepared for the workforce.
- Lack of emphasis on soft skills needed in jobs e.g. communication skills, interpersonal skills, analytical skills, working attitude etc.

3.2 Outcome Based Education (OBE):

Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes. Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4to 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular engineering degree is predetermined and the students are evaluated for all the required parameters (Outcomes) during the course of the program.

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

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

Outcome-Based Education (OBE) model is being adopted in Engineering colleges now-a-days as per AICTE guidelines. It is considered as a giant leap forward to

improve technical education in India and help Engineers compete with their global counterparts.

3.3 Traditional Education Vs Outcome Based Education

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

Sr. No	Traditional Teaching Approach	Outcome Based Approach
01	Teacher-centered	Learner/Student centered
02	Teacher's role as instructor	Teacher's role as facilitator
03	Focus on teacher's input	Focus on learner's output
04	Rigid and controlling	Flexible and empowering
05	Emphasis on products	Emphasis on program and overall learning
06	Syllabus/Course objectives is seen rigid and non-negotiable	Learning outcomes are seen as guides that allow teachers to be innovative and creative in achieving learning outcomes.
07	Norm-reference assessment	Criterion reference assessment
08	Content based and content delivery	Ability building and skill development

3.4 Why OBE?

- International recognition and global employment opportunities.
- More employable and innovative graduates with professional and soft skills, social responsibility and ethics.
- Better visibility and reputation of the technical institution among stakeholders.
- Improving the commitment and involvement of all the stakeholders.
- Enabling graduates to excel in their profession and accomplish greater heights in their careers.
- Preparing graduates for the leadership positions and challenging them and making them aware of the opportunities in the technology development.

3.5 Benefits of OBE

Clarity: The focus on outcome creates a clear expectation of what needs to be accomplished by the end of the course.

Flexibility: With a clear sense of what needs to be accomplished, instructors will be able to structure their lessons around the students' needs.

Comparison: OBE can be compared across the individual, class, batch, program and institute levels.

Involvement: Students are expected to do their own learning. Increased student's involvement allows them to feel responsible for their own learning, and they should learn more through this individual learning.

- Teaching will become a far more creative and innovative career
- Faculty members will no longer feel the pressure of having to be the "source of all knowledge".
- Faculty members shape the thinking and vision of students towards a course.

3.6 Expectations of Students Under OBE

- Students are expected to be able to do more challenging tasks rather than memorize and reproduce what was taught.
- Students should be able to: write project proposals, complete projects, analyze case studies, give case presentations, show their abilities to think, question, research, and make decisions based on the findings.
- Be more creative, able to analyze and synthesize information.
- Able to plan and organize tasks, able to work in a team as a community or in entrepreneurial service teams to propose solutions to problems and market their solutions.
- Students should be enriched on three-dimensional scales of knowledge, skill and attitude throughout the course.

3.7 Features of OBE

- OBE is an educational process that focuses on what students can do or the qualities they should develop after they are taught. OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of higher order learning and mastery rather than accumulation of course credits.

- Both structures and curricula are designed to achieve those capabilities or qualities.
- Discourages traditional education approaches based on direct instruction of facts and standard methods.
- It requires that the students demonstrate that they have learnt the required skills and content.

3.8 India, OBE and Accreditation:

National Board of Accreditation (NBA) was established by All India Council for Technical Education (AICTE). In January 2010, NBA became an independent Autonomous body. This transition allowed it to operate flexibly and focus on ensuring quality and relevance in technical education. Its primary role is to assess the quality and competence of technical program offed by educational institutions for diploma, Graduation and post-graduation in fields such as engineering, technology, management, pharmacy, architecture and related disciplines. NBA accredits specific program rather than entire institutes.

From 13 June 2014, India has become the permanent signatory member of the Washington Accord. This recognition enhanced the global acceptance of Indian engineering programs. Hence in 2014 NBA started accrediting only the program running with OBE that is implementation of OBE in higher technical education started in India.

National Assessment and Accreditation Council (NAAC) is an autonomous body established by University Grants Commission (UGC) in 1994 to assess and accredit Higher Education Institutions (HEIs) in India as per recommendation of National Policy of Education (NEP 1986). NAAC evaluates colleges and universities across various dimensions including teaching-learning process, research, infrastructure, governance, and student support services. With the implementation of National Education Policy (NEP 2020), NAAC also expects the implementation of OBE in higher education while accrediting the institution.

3.9 Preparing for OBE Implementation

Questions to be Answered:

- What is the psychological significance of OBE?
- What are the various components of OBE?

- How do you align OBE components such as vision, mission and Programme Educational Objectives?
- How to design course outcome?
- What are the various components involved in evaluating course attainment?
- How higher order thinking is applied in assessment of Course outcome?
- How course outcome attainment is mapped to overall Programme Outcome?

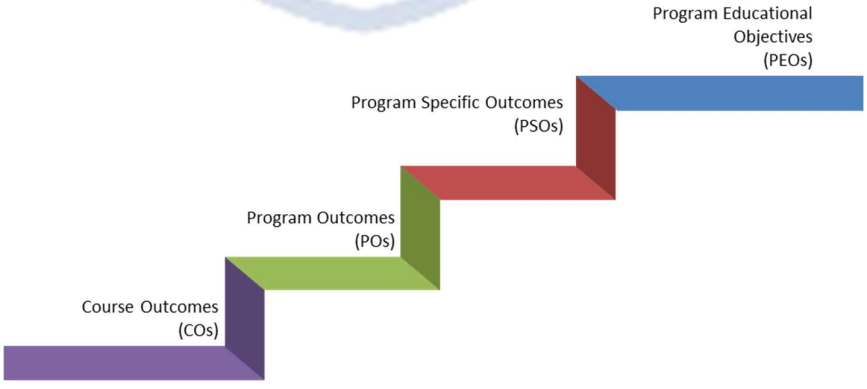
3.10 Four levels of outcomes from OBE: Four levels of outcomes from OBE are

1. Program Educational Objectives (PEO) (Few Years After Graduation)

2. Program Outcomes (PO) (After Completion of Graduation)

3. Program Specific Outcomes (PSO) (After Completion of Graduation)

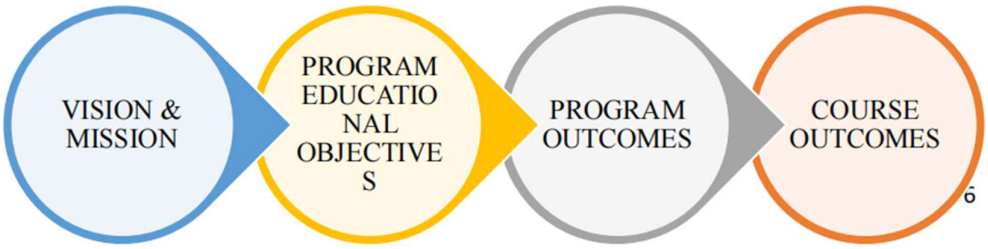
4. Course Outcomes (CO) (After Completion of Course)



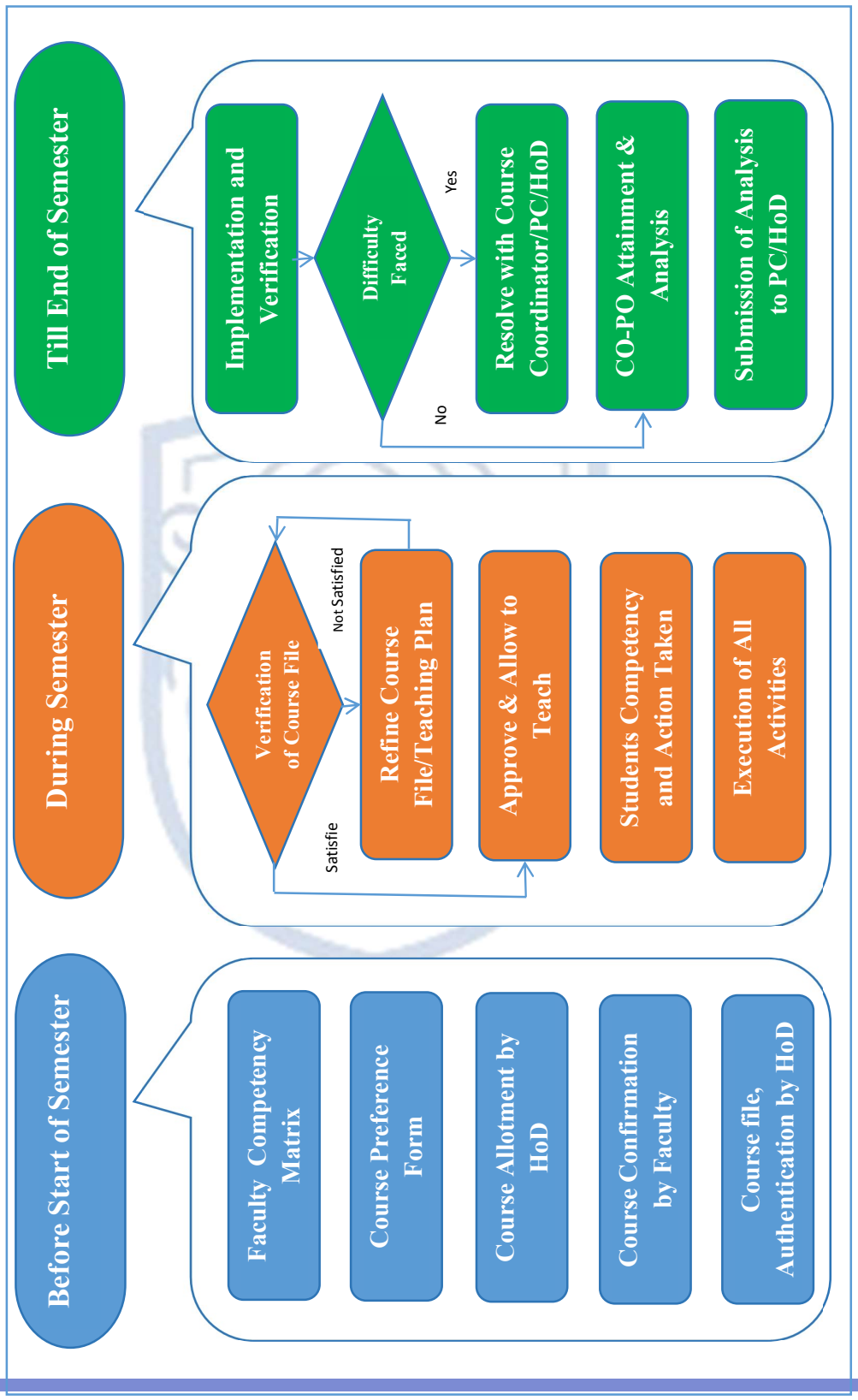
3.11 Implementation of OBE

- Define the Vision and Mission statements for both the Institute and department
- Define Program Educational Objectives (PEO)
- Program Outcome (PO) & Program Specific Outcome Statements (PSOs)
- Define Course Objectives and Course Outcome (COs)
- Map Course Outcomes (COs) with Program Outcomes (POs)
- 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 etc
- Define various assessment tools such as Assignments, Quizzes, Class Test, Course End Survey etc
- 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.



4. OBE Framework of an Institute



5.Vision, Mission and PEOs

5.1 Vision and Mission Statement Philosophy

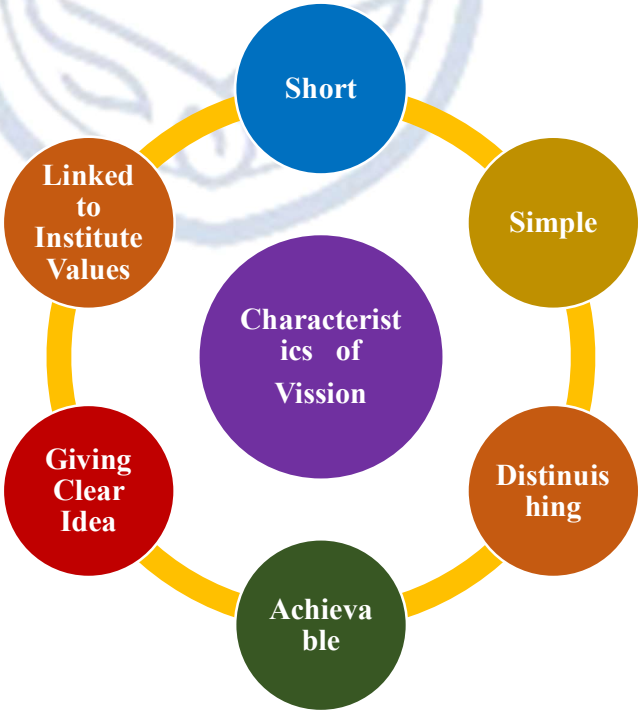
- Statements help in defining aspirations and to remain focused
- Should be written in a simple language, easy to communicate and should define objectives which present near future of the Institute
- Vision statement is dream of where one wants the Institute to be and inspires all the stake holders
- Mission statements are actionable statements that guide the stake holders to act

5.2 Purpose of Vision and Mission

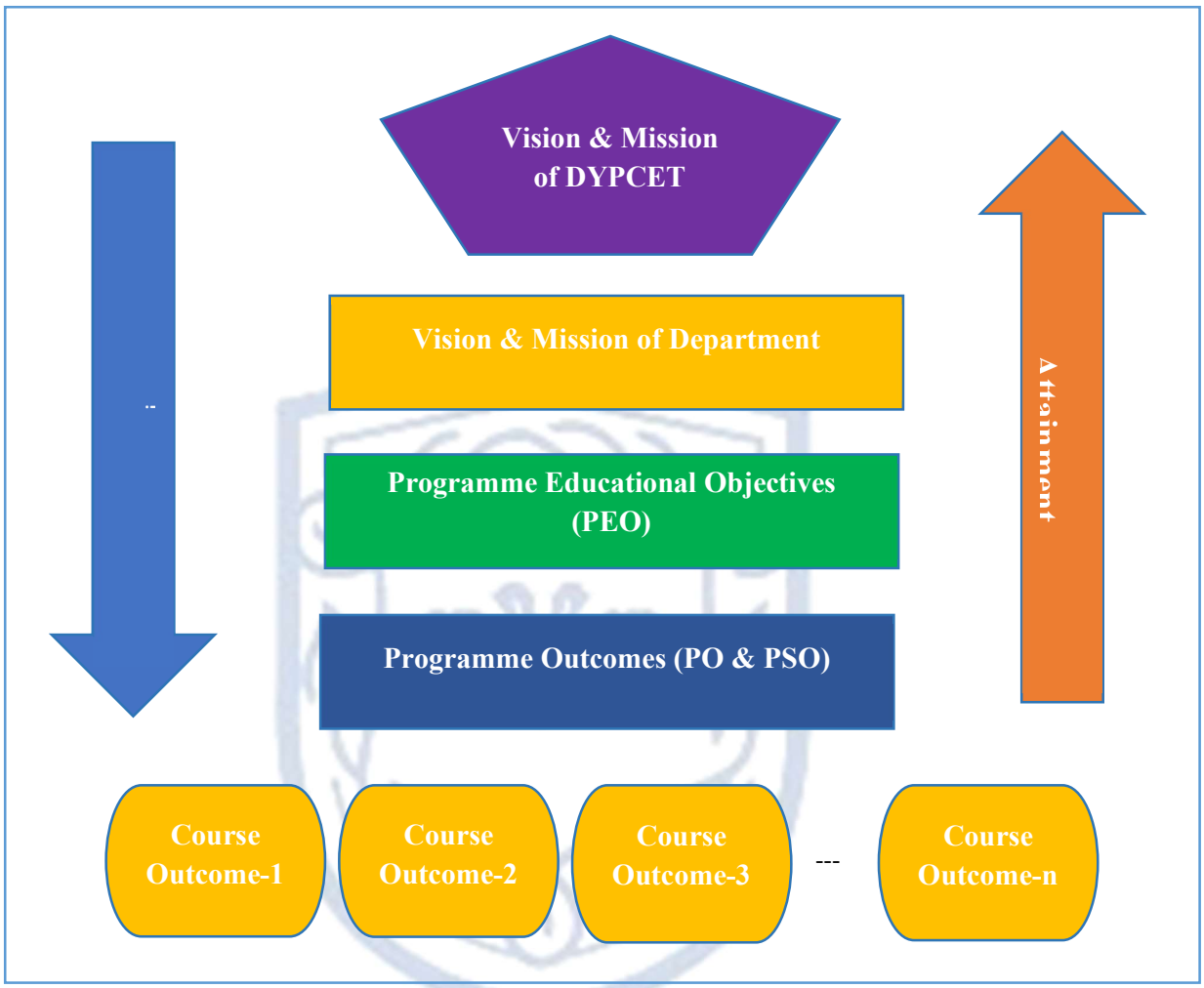
Purpose of Vision: The primary purpose of a vision statement is to motivate and guide internal stakeholders and external stakeholders by presenting a compelling picture of what the organization aims to become.

Purpose of Mission: The Mission statement is a guiding principle for daily operations and decision making. It provides a framework for aligning actions with the organization's values and objectives.

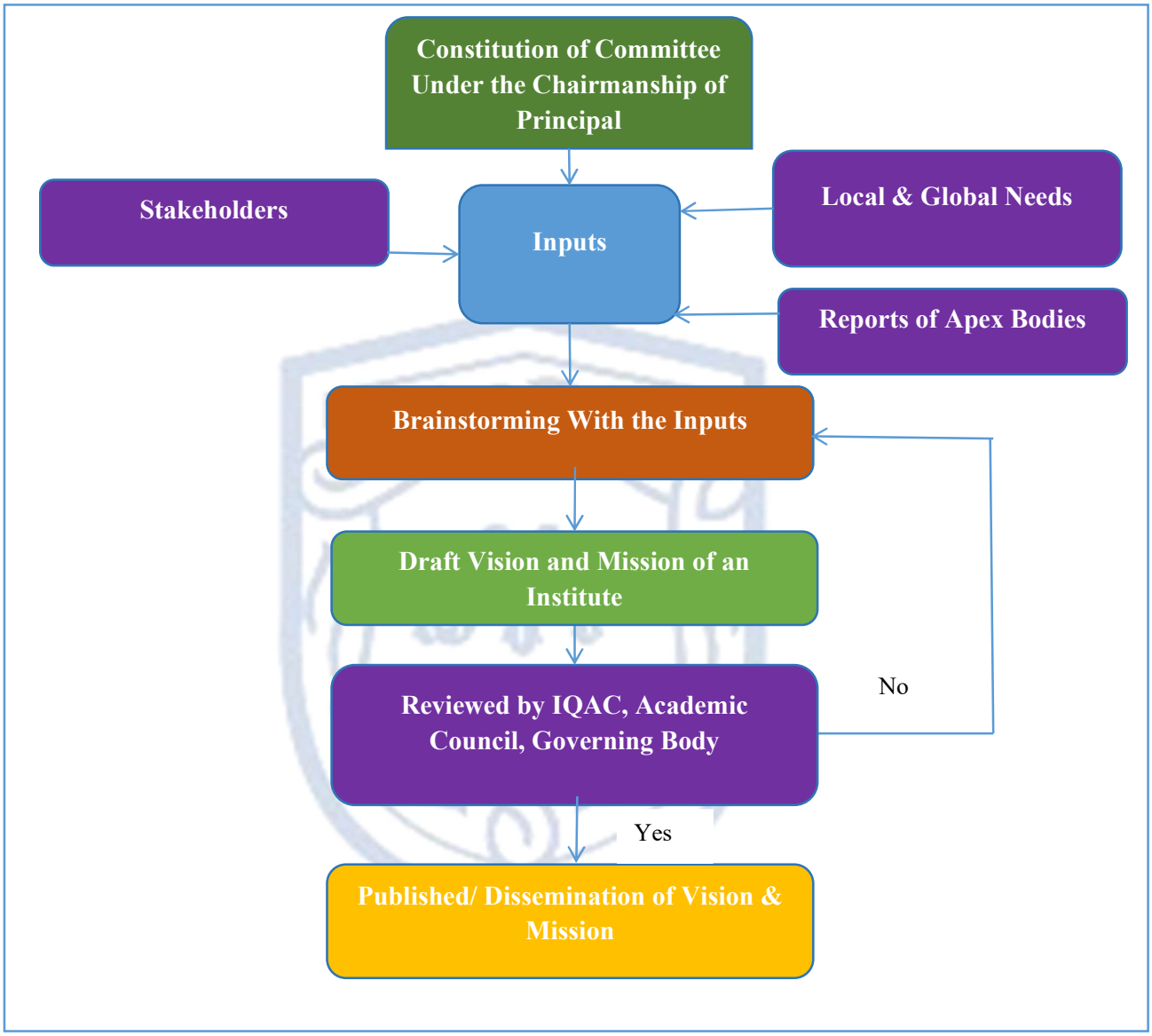
5.3 Characteristics of Vision Statement



5.4 Key Constituents of OBE



5.5 Process for Defining the Vision and Mission of the Institute



5.6 Institute Vision

To become a leading Institute in producing high quality technical professionals for Nation Building.

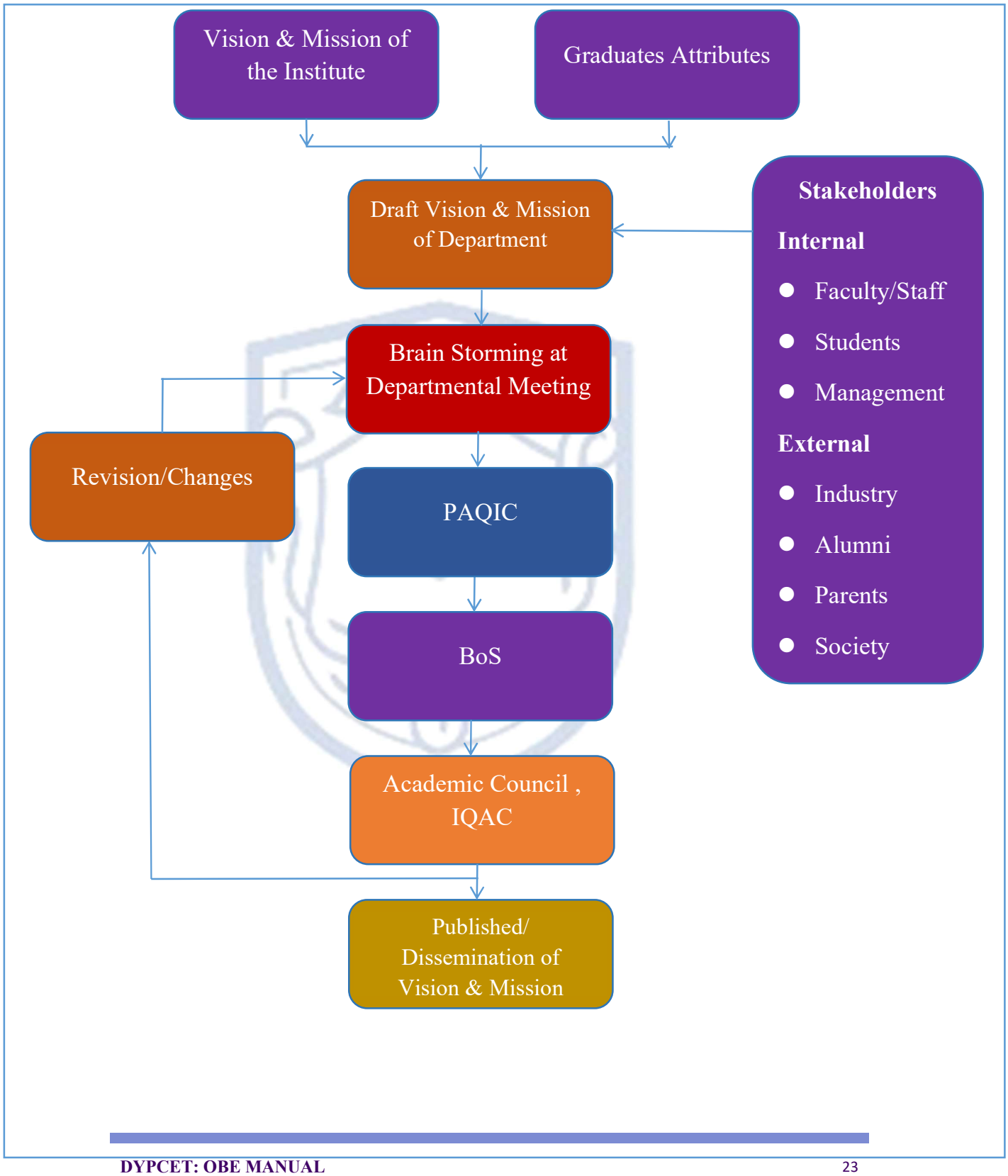
5.7 Institute Mission

- To nurture the students with high quality education.
- To promote creativity, excellence and discipline.
- To explore career opportunities for the students.
- To enhance industry-institute interaction and research activities.
- To create social and environmental awareness.

5.8 Organizational Objectives

- To produce technically competent, quality conscious engineers.
- To develop functionally suitable and conducive environment for students and staff for academic purpose.
- To develop the departments into the centre of excellence.
- To strengthen industry institute interaction.
- To help the students for personality development and career guidance.

5.9 Process for Defining the Vision and Mission of the Department



5.10 Department Wise Vision and Mission Statement

Department wise Vision and Mission Statement are as follows:

1.Civil Engineering

Vision: To impart knowledge and excellence in the field of civil engineering from global perspectives to the students and to inculcate professional ethics.

Mission:

- To provide quality education through conducive teaching learning environment.
- To enhance interaction with industry and research organizations to meet the requirements of curriculum, research and consultancy services.
- To inculcate moral, ethical values and entrepreneurial skills among the students for the development of the society.

2. Chemical Engineering

Vision: To achieve academic excellence through promoting research environment and industry interaction to produce quality technical graduates for the betterment of the society.

Mission:

- To impart quality education to achieve global competitiveness.
- To inculcate sensitivity towards society, environment and ethics.
- To serve the nation by graduating the broadly educated engineers in diversified fields.
- To promote inspiring environment of learning research and innovations.
- To promote industry institute interaction and entrepreneurial attitude.

3. Computer Science & Engineering

Vision: To create technocrats with a flair of advanced technology in Computer Science and Engineering so as to satisfy the Industrial and Societal needs.

Mission:

- To facilitate students with latest hardware, software technologies and technical expertise.
- To inspire and nurture creativity amongst the students.
- To make the students industry ready and inculcate entrepreneurship skills.
- To enrich students' technical skills for finding innovative solutions to societal needs.

4.Computer Science & Engineering - Artificial Intelligence and Machine Learning

Vision: To develop competent professionals in AI & ML contributing globally to the benefit of industry and society.

Mission:

- To develop state-of-the-art academic and infrastructural facilities with modern equipment and other learning resources to produce self-sustainable professionals.
- To collaborate with Industry through project-based learning, and internships enabling the students to explore and apply various learning directions.
- To equip students with interdisciplinary skill sets to build intelligent systems which in turn provides dynamic and promising careers in the global marketplace.

5.Computer Science & Engineering-Data Science

Vision: To impart quality education among students which instils application of technical skills for problem solving in the domain of data science with a pivotal focus to prepare them for the industry, research and societal needs.

Mission:

- To impart quality education that goes beyond theoretical knowledge, equipping students with practical, hands-on technical skills in data science
- To nurture problem-solving abilities and critical thinking in the era of data analytics with cutting edge tools and techniques.

- To study and implement data intensive system which strengthens socio-economic aspects and solves multidisciplinary problems.

5. Electronics and Telecommunication Engineering

Vision: To achieve excellence in Electronics and Telecommunication Engineering to support nation building by producing quality technical professionals.

Mission:

- To impart quality education
- To stimulate design ability, innovations, dedication and discipline among the students.
- To enhance industry interactions, research activities and awareness of career opportunities.
- To use their knowledge for the benefit of society.

6. Mechanical Engineering

Vision: To provide excellent education in the field of mechanical engineering with effectual education, skill development and practical approach to make student competent for professional challenges of life.

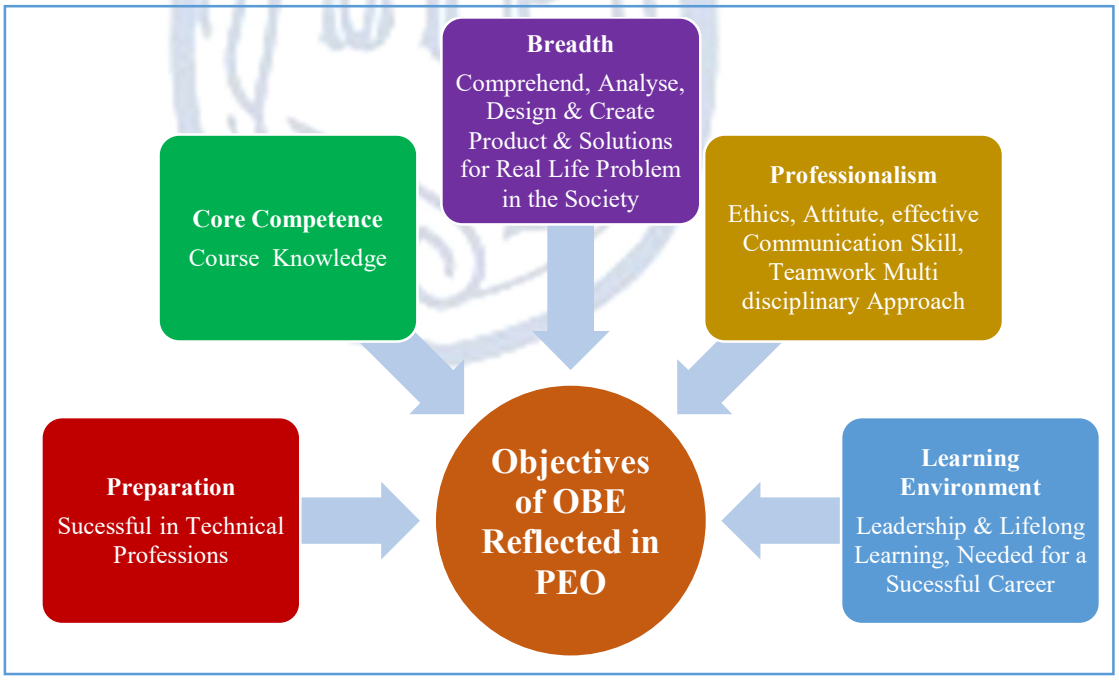
Mission:

- Prepare effective and responsible graduates for global requirements by providing quality technical education and enable them to be leaders and pioneers in their field.
- Provide a program of professional study grounded in engineering fundamentals augmented by the development of interpersonal skills, social values, experimental learning and flair for life-long learning.
- Establish center of competence to conduct basic and applied research in core area and strengthen the link with industry based on their need.

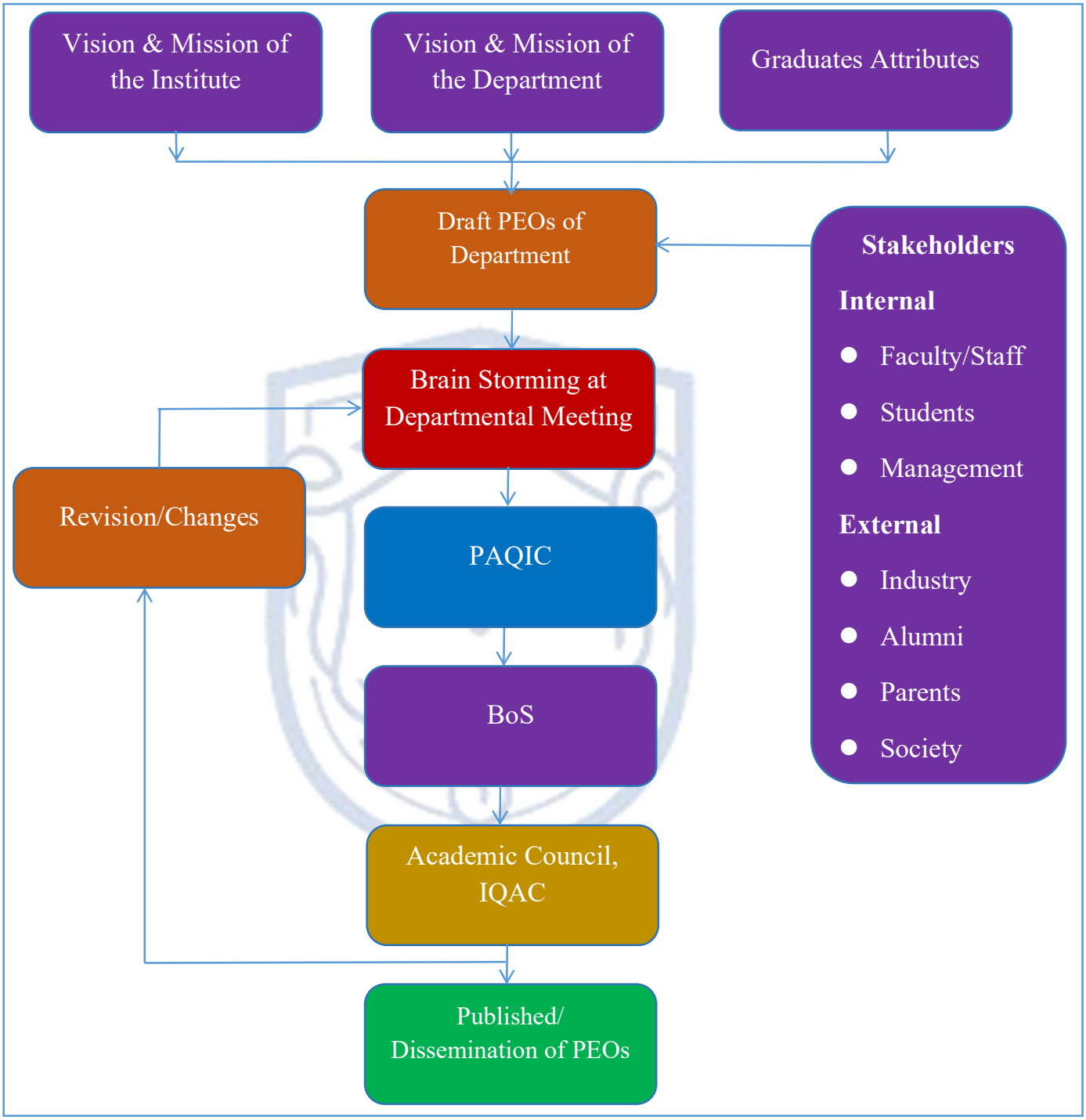
5.11 Program Educational Objectives (PEOs)

- Program Educational Objectives (PEOs) are broader statements that describe the career and professional accomplishment in three to five years after graduation of the students
- PEOs should be consistent with mission statements
- PEOs should be measurable and achievable by the program
- Program should follow established process of defining statements
- PEOs process is similar to as that of Vision and Mission statement
- PEOs must be published and shared with all stakeholders
- Key Elements: Professional Success-Lifelong learning, Higher education, Research-Ethical professional practice- communication skill-team work-leadership

5.12 Objectives of OBE Reflected in PEOs



5.13 Process for Defining the PEOs



5.14 Department Wise PEOs Statement are as follows

1.Civil Engineering

PEO1: To train the students for developing logical and lateral thinking and understanding basic fundamental concepts of civil engineering.

PEO2: To inculcate an awareness of social, environmental aspects and codes of professional practice among the students.

PEO3: To prepare students for successful careers in infrastructure development for nation building.

PEO4: To enhance soft skills of the students for their overall development.

2.Chemical Engineering

PEO1: Acquire the knowledge of modern experimental and computational skills which is used to solve real-time chemical engineering problems.

PEO2: Ability to solve chemical engineering problems of practical relevance to society while complying with economical, environmental, ethical and safety consideration.

PEO3: Update the knowledge for chemical and allied industries to achieve professional excellence, ethics and leadership qualities.

3.Computer Science & Engineering

PEO1: To apply the knowledge of mathematics and computer science and engineering to provide realistic solutions to the problems in their domain.

PEO2: To exhibit technical skills to analyze, design and develop solutions for engineering issues by using innovative methods, cutting edge tools and techniques.

PEO3: To apply professional practices, ethical principles and improve communication skills to enhance the career avenues.

PEO4: To display thirst for emerging technologies and inquisitiveness to tackle societal and environmental needs.

4.Computer Science & Engineering - Artificial Intelligence and Machine Learning

PEO1: To provide graduates with the proficiency to utilize the fundamental knowledge of Computer Science, Mathematics, Artificial Intelligence, and Machine Learning to Provide Industry Accepted Solutions.

PEO2: To enable students to exercise problem-solving capacity with effective use of analysis, design, and development that address idea realization.

PEO3: Demonstrate Effective Communication, engage in teamwork, Exhibit Leadership Skills and ethical Attitude, and Achieve Professional Advancement through Continuing Education.

5.Computer Science & Engineering-Data Science

PEO1: Graduates will demonstrate successful careers in data science-related fields, holding positions that leverage their skills and knowledge in organizations such as industry, academia, government, or research institutions.

PEO2: Graduates will pursue continuous professional development to keep up with emerging trends in data science.

PEO3: Graduates will engage with the community applying their data science expertise to address societal challenges.

PEO4: Graduates will have ethical and moral leadership positions in their organizations, actively contributing to decision-making processes in the era of data science.

6. Electronics and Telecommunication Engineering

PEO1: To educate students by providing good theoretical and practical knowledge which leads to excellent performance at various examinations and to achieve employment in different fields

PEO2: To enable students to solve Electronics and Telecommunication engineering problems by applying basic principles of applied mathematics and science to fulfil societal needs

PEO3: To enable students to design and develop a system as per the need of the industry

PEO4: To enrich the students with professional skills so as to sustain in a global organization

7. Mechanical Engineering

PEO1: To engage in ongoing learning and professional development through self-study, continuing education in mechanical engineering and also in other allied fields.

PEO2: To apply engineering skills, exhibit critical thinking and problem-solving skills in professional engineering practices or tackle social, technical and business challenges.

PEO3: To adopt ethical attitude and exhibit effective skills in communication, management, teamwork and leadership qualities.

5.15 Assessment of PEOs

Some effective methods to assess the success of PEOs

1. **Alumni Surveys:** Conduct Alumni survey with graduates to get information about their career, achievements, professional development, and how well the program prepared them for their careers.
2. **Employer Feedback:** Collect the feedback from employers about the performance and competencies of graduates.
3. **Career Track Record:** Regularly monitor the career progress of graduates which includes job placements, promotions, education updation, salary levels, job satisfaction
4. **Professional Certifications:** Regularly track the number of graduates who obtained relevant professional certificates.
5. **Focus Group:** Focus with alumni, employers to discuss the relevance and effectiveness of the PEOs.

5.16 Publication and Dissemination of Vision, Mission, PEO

The Vision, Mission and Program Educational Objectives (PEOs) statements are prominently displayed and accessible to all the stakeholders at the significant locations at the Institute. The list of places where vision, mission and PEOs are publication and dissemination is described below.

Publication and Dissemination of Institute Vision and Mission Statement

- Institute Website
- Executive Director Cabin
- Principal Cabin
- Dean Cabin
- HOD Cabin
- Institute Administrative office

- Canteen
- Board Rooms
- Library
- Central Computing Facility
- Institute Booklets
- Social Media Platforms
- Campus Recruitment Meeting
- Students Orientation program
- Parents Meeting
- Alumni Meeting
- Academic Council Meeting
- Students Induction Program

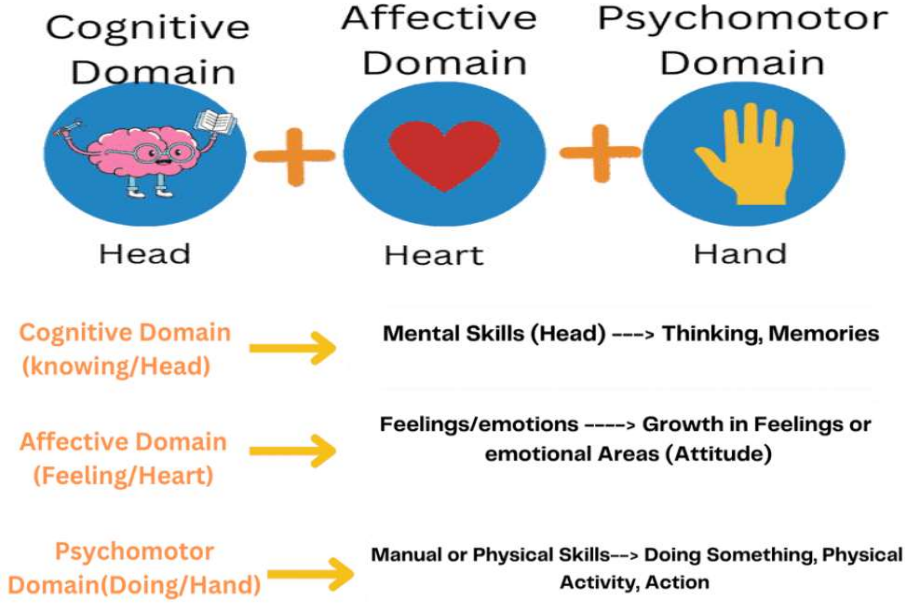
Publication and Dissemination of Department Vision and Mission Statement

- HOD Cabin
- Departmental Corridors
- Departmental Library
- Laboratories
- Curriculum
- Notice Boards
- Lab. Manuals and Course Files
- Students News Letter
- Department Magazines
- Conference/FDP/Workshop Bouchers
- Social Media Platforms
- Students Induction Program
- Course Orientation
- Students Orientation program
- Parents Meeting
- Alumni Meeting
- PAQIC Meeting
- BoS meeting
- Guest Lectures

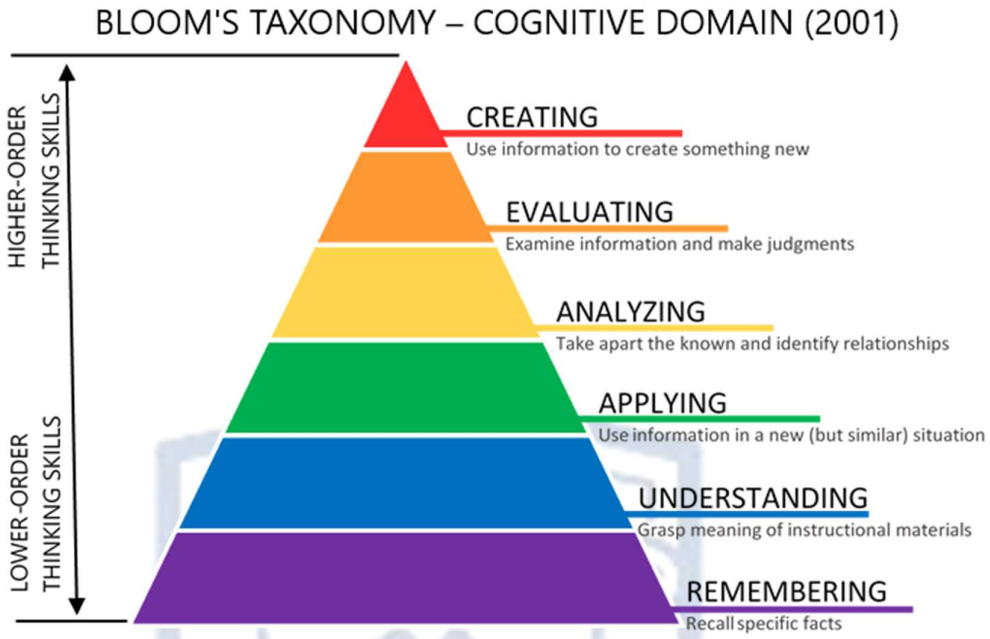
6. Revised Bloom's Taxonomy

6.1 Introduction

Bloom's Taxonomy provides an important framework to not only design curriculum and teaching methodologies but also to design appropriate examination questions belonging to various cognitive levels. Bloom's Taxonomy of Educational Objectives developed in 1956 by Benjamin Bloom was widely accepted by educators for curriculum design and assessment. In 2001, Anderson and Krathwohl modified Bloom's Taxonomy to make it relevant to the present-day requirements. It attempts to divide learning into three types of domains (cognitive, affective and behavioral) and then defines the level of performance for each domain. Conscious efforts to map the curriculum and assessment to these levels can help the programs to aim for higher-level abilities which go beyond remembering or understanding, and require application, analysis, evaluation or creation. Revised Bloom's taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge. It is popular framework in engineering education to structure the assessment as it characterizes complexity and higher-order abilities. It identifies six levels of competencies within the cognitive domain which are appropriate for the purposes of engineering educators. Bloom's Taxonomy is hierarchical, meaning that learning at the higher level requires those skills which are attained at a lower level.



6.2 Bloom Taxonomy Cognitive Domain



6.3 Action Verbs for Course Outcomes

Lower Order of Thinking (LOT)			Higher Order of Thinking (HOT)		
Knowledge	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Define	Explain	Solve	Analyse	Reframe	Design
Describe	Describe	Apply	Compare	Criticize	Create
List	Interpret	Illustrate	Classify	Judge	Plan
State	Summarise	Calculate	Distinguish	Recommend	Formulate
Match	Compare	Sketch	Explain	Grade	Invent
Tabulate	Discuss	Prepare	Differentiate	Measure	Develop
Record	Estimate	Chart	Appraise	Test	Organize
Label	Express	Choose	Conclude	Evaluate	Produce

6.4 Action Verbs for Assessment

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	➢ Ability to recall of information like facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria ➢ Ability to recall methodology and procedures, abstractions, principles, and theories in the field ➢ Knowledge of dates, events, places ➢ Mastery of subject matter	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where
2. Understand	➢ Understanding information ➢ Grasp meaning ➢ Translate knowledge into new context ➢ Interpret facts, compare, contrast ➢ Order, group, infer causes ➢ Predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss
3. Apply	➢ Use information ➢ Use methods, concepts, laws, theories in new situations ➢ Solve problems using required skills or knowledge ➢ Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyze	➢ Break down a complex problem into parts ➢ Identify the relationships and interaction between the different parts of a complex problem ➢ Identify the missing information, sometimes the redundant information and the contradictory information, if any	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select
5. Evaluate	➢ Compare and discriminate between ideas ➢ Assess value of theories, presentations ➢ Make choices based on reasoned argument ➢ Verify value of evidence ➢ Recognize subjectivity ➢ Use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	➢ Use old ideas to create new ones ➢ Combine parts to make (new) whole, ➢ Generalize from given facts ➢ Relate knowledge from several areas ➢ Predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

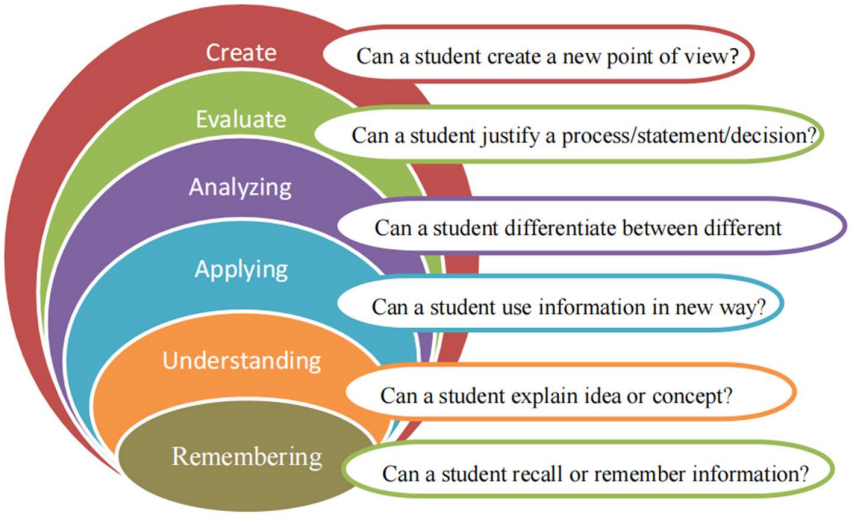
6.5 Knowledge Domain:

1. **Factual Knowledge:** Basic elements students must know to be acquainted with a discipline
2. **Conceptual Knowledge:** Interrelationship among the basic element within a large structure.
3. **Procedural Knowledge:** How to do something, methods of inquiry and criteria for using skills
4. **Metacognitive Knowledge:** Awareness and understanding of one's own thought processes.

The Knowledge Dimension			
Concrete Knowledge		→	**Abstract knowledge**
Factual	**Conceptual**	**Procedural**	**Metacognitive**
• Knowledge of terminologies • Knowledge of specific details & elements	• Knowledge of classifications and categories • Knowledge of principles & generalizations • Knowledge of theories, models & structures	• Knowledge of subject specific skills and algorithms • Knowledge of subject specific techniques and methods • Knowledge of criteria for determining when to use appropriate procedures	• Strategic Knowledge • Knowledge about cognitive task, including appropriate contextual and conditional Knowledge • Self- Knowledge

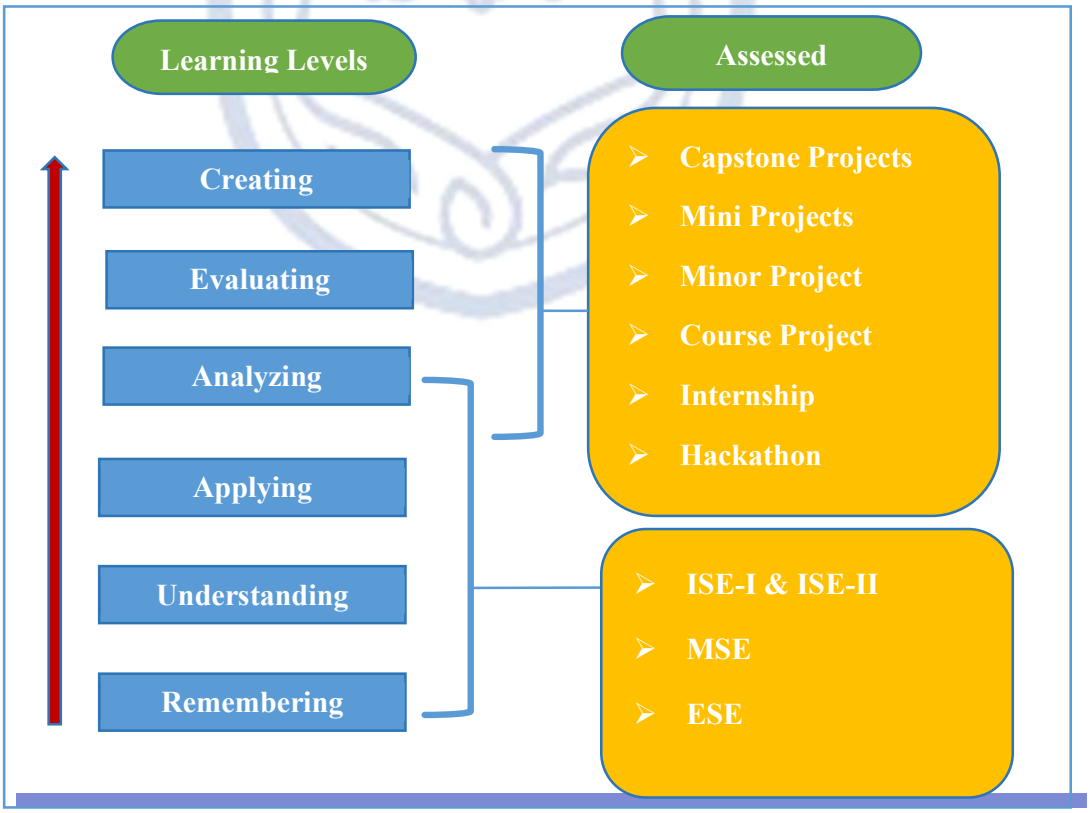
Example (Use of action verb w.r.t knowledge dimension and order of thinking)

Use of action verbs	**Factual**	**Conceptual**	**Procedural**	**Metacognitive**
Remember	**List** properties of soil	**Recognize** characteristic of material	***Explain*** *working of pump*	**Identify** strategies for report writing
Understand	**Summarize** features of a new product.	**Classify** adhesives by toxicity.	**Explain** assembly instructions.	**Predict** the behavior of member
Apply	**Respond** to frequently asked questions.	**Provide** advice to team members	**Carry out** pH tests of water samples.	**Use** modern techniques to get solution
Analyse	***Explain*** *the selection of tool/activity.*	**Differentiate** LOT and HOT	**Integrate** compliance with regulations.	**Assess** the project work
Evaluate	**Select** the appropriate tool	**Determine** relevance of results.	**Judge** efficiency of sampling techniques.	**Reflect** on one's progress.
Create	**Generate** a log of daily activities.	**Assemble** a team of experts.	**Design** efficient project workflow	**Create** a learning portfolio.



6.6 Assessment Planning

Normally the first three learning levels; Remembering, Understanding, Applying and to some extent fourth level Analyzing are assessed in the continuous internal evaluation (ISE, MSE) and Semester End Examination (ESE), where students are given a limited amount of time. And abilities, Analysis, Evaluation and Creation can be assessed in extended course work or in a variety of students work like course projects, Mini/Minor project, Internship and final year capstone projects.



7. Course Outcomes (COs)

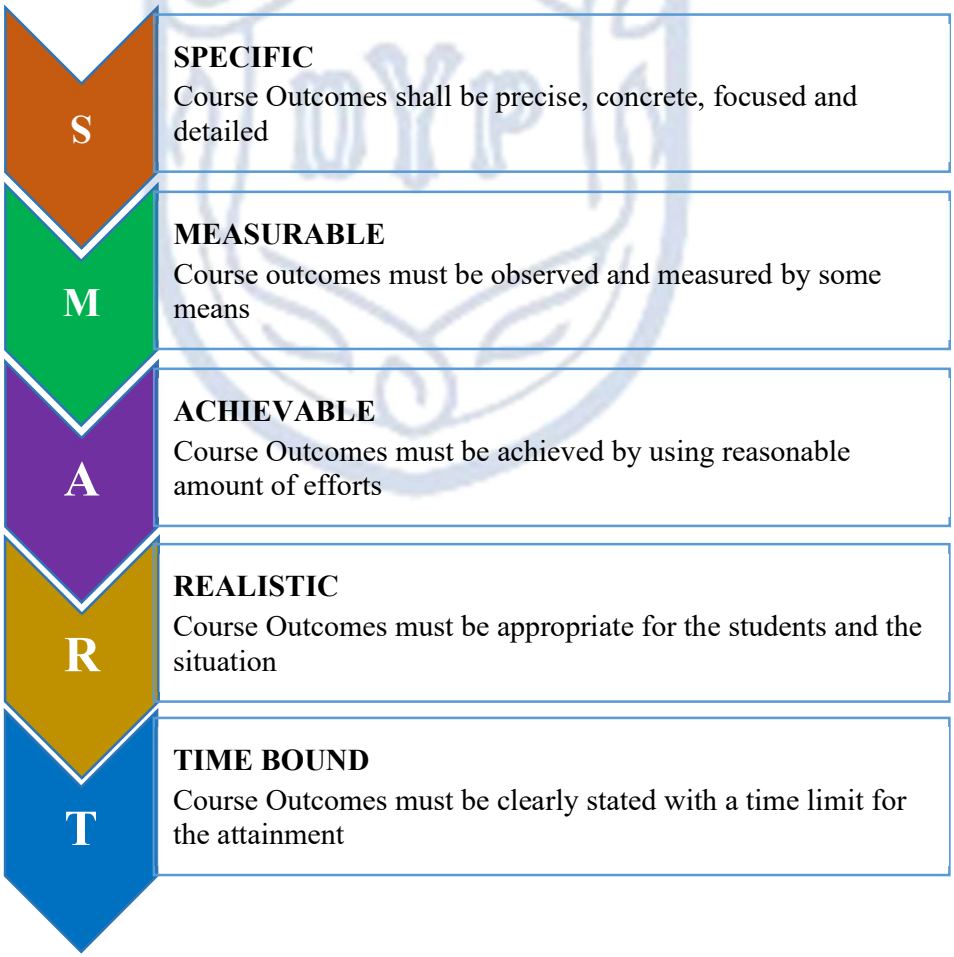
7.1 Guidelines for Writing Course Outcomes (COs) Statements

Course Outcomes (COs): Statements indicate, what a student can do after the successful completion of a course. Every Course leads to some Course Outcomes. The CO statements are defined by considering the course content covered in each unit of a course. For every course there may be 4 to 6 COs. The keywords used to define CO are based on Bloom's Taxonomy.

Well-written course outcomes involve the following parts:

- Action verb
- course content
- Level of achievement as per BTL
- Modes of performing task (if applicable)

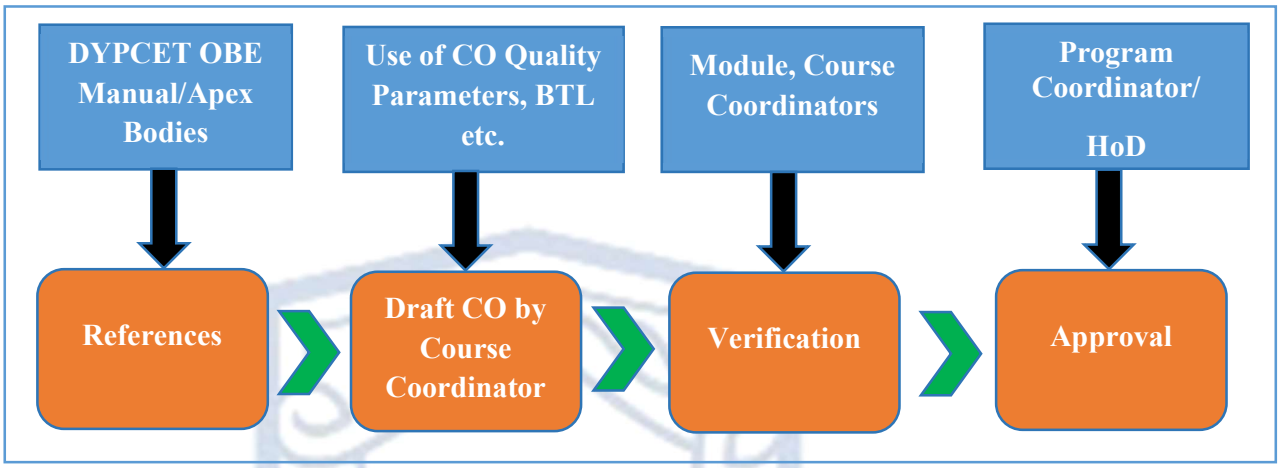
7.2 SMART statement for writing COs



Note: If Laboratory is given as separate course (with course code) then there should be separate course outcomes for laboratory.

7.3 Quality of Course Outcome

Process at department level to maintain quality of CO



7.4 Guidelines/Checklist for COs

Number of COs	4 to 6
CO essentials	Action Verb, Course Content, Level of Achievement, modes of Performing task (If Applicable)
Based on BTL?	Understand, Remember, Apply, Analyse, Evaluate, Create
Number of BTL Considered in one course	Minimum 1, Maximum 3
Technical Content/ point of curriculum?	All curriculum contents are covered
Curriculum gap	Additional CO for gap identified/filling. Adds more weightage

7.5 Dos and Don't s

Dos:

- Use measurable verbs
- Be specific and clear
- Focus on student's performance
- Be realistic and achievable
- Align with program outcomes

Don'ts

- Don't use multiple verbs in one CO statement
- Avoid vague language
- Avoid overly ambitious goals
- Avoid jargon a complex language
- Don't focus on teaching activities

Note:

1. Faculty members may draft COs statement unit wise or multi-unit COs statement.
2. If any faculty needs /feel to revise COs statements, then he/she may be with the approval of PC/HoD and PAQIC with proper justification and documentation.

7.6 Sample Course Outcomes

Course Title: Physics or Mechanical Engineering

Course Code: 241MEBSCL104

Teaching Scheme L-T-P :03-01-00

Evaluation Scheme ISE-I, MSE, ISE-II:10/30/10

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
104.1	**Explain** elastical analysis of materials for engineering applications
104.2	**Use** the classical mechanics for moment diagrams
104.3	**Apply** the fluid flow mechanics for liquids
104.4	**Apply** laws of mechanics for system of motions of bodies
104.5	**Identify** the physical parts of the DC machines
104.6	**Describe** electronic devices using electromagnetic induction law

8. The Program Outcomes (POs) Defined by NBA

The Program Outcomes (POs) as defined by the NBA, are specific statements that describe what students are expected to know and be able to do by the time they graduate from the program. POs are essential criteria used by the NBA to assess the quality and effectiveness of engineering program. These PO are aligned with OBE goals and focus on the knowledge, skills, and attitudes.

8.1 Key Aspects of Program Outcomes by NBA

Knowledge: Understanding of fundamental and advanced concepts in the field of study.

Skills: Practical abilities and technical skills relevant to the discipline.

Attitudes: Professional and ethical behavior, team work and communication skills

8.2 Program Outcomes (POs)

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

8.3 Revised POs Statements as per NBA (July 2024)

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 to the solution of complex engineering problems.

PO2- Problem Analysis: Identify, formulate, review research literature and analyze 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

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)

8.4 A Washington Accord Program: Knowledge and Attitude Profile (WK)

A Washington Accord Program provides: Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the **natural sciences** applicable to the discipline and awareness of relevant **social sciences**

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

WK3: A systematic, theory-based formulation of **engineering fundamentals** required in the engineering discipline

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.

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

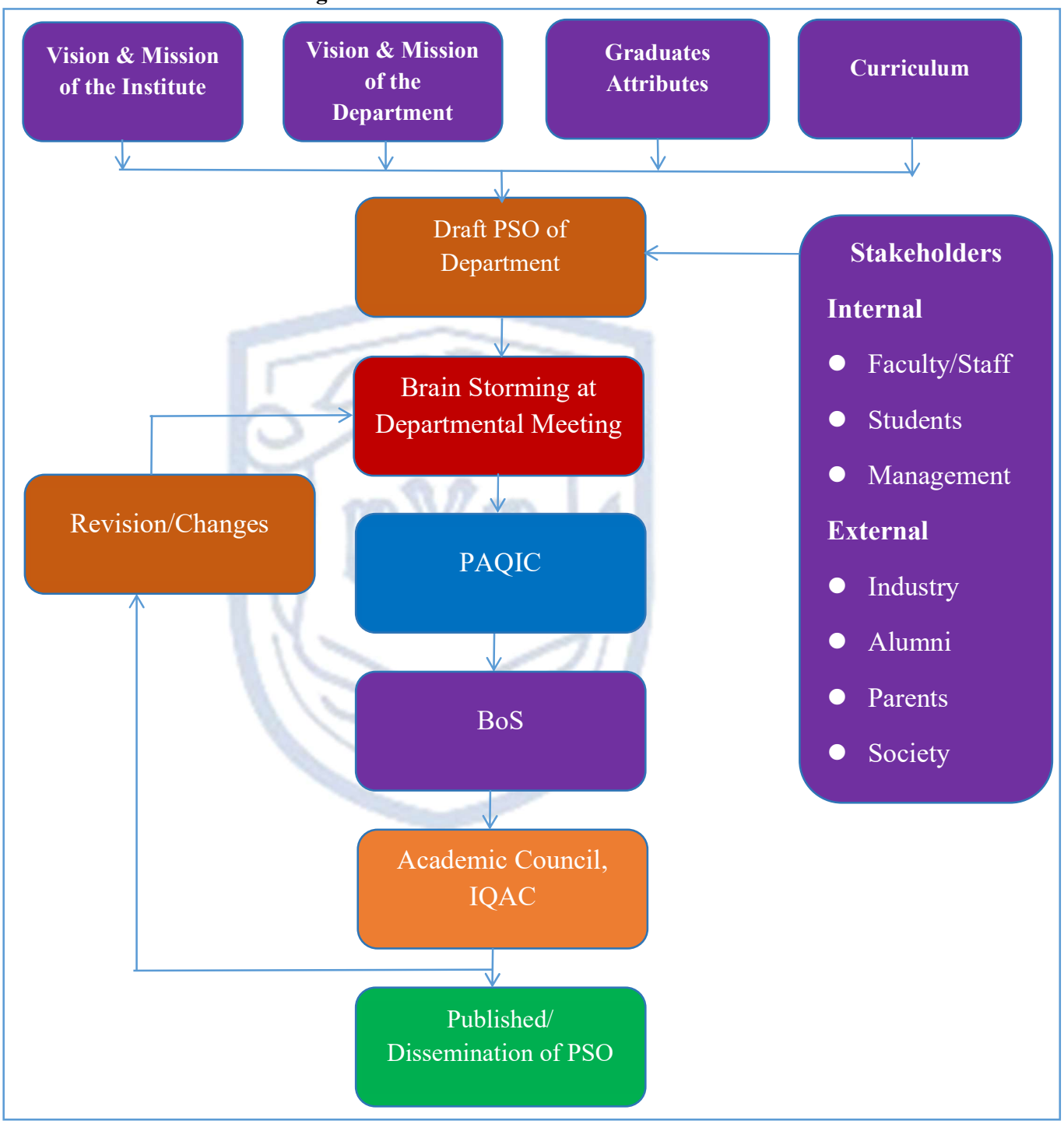
WK6: Knowledge of **engineering practice** (technology) in the practice areas in the engineering discipline

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.**

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

WK9: Ethics, inclusive behavior 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

8.5 Process for Defining the PSO



8.6 Department Wise PSO Statements

1.Civil Engineering

PSO1: To design and execute cost effective civil engineering solutions for sustainable development

PSO2: To develop Entrepreneur skills among the graduates to fulfill the needs of society.

2.Chemical Engineering

PSO1: Chemical Engineering graduates are able to handle real world problems of Chemical, petrochemical and allied industries

PSO2: Chemical engineering graduates are capable to design and develop industrial processes along with advanced simulation software's

3.Computer Science & Engineering

PSO1: To demonstrate ability in problem-solving, algorithmic thinking and effective technical Communication skills to provide solutions for societal issues.

PSO2: Apply the design and deployment principles to deliver a quality software product using emerging IT technologies for solving the complex real time problems.

4.Computer Science & Engineering - Artificial Intelligent and Machine Learning

PSO1: Graduates should be able to apply AI-based skills for effective decision-making Machine in several domains such as business and governance domains.

PSO2: Graduates should be able to use tools and techniques in Artificial Intelligence and Learning for Solving Multidisciplinary Problems

5.Computer Science & Engineering-Data Science

PSO1: Graduates will be able to apply fundamental principles of data science, methodologies, and modern tools to analyze complex datasets, extracting meaningful insights and making data-driven decisions.

PSO2: Graduates will be able to design, implement, and apply diverse data-centric algorithms, including machine learning, deep learning, computer vision and statistical analysis, to solve real-world problems across various domains.

6.Electronics and Telecommunication Engineering

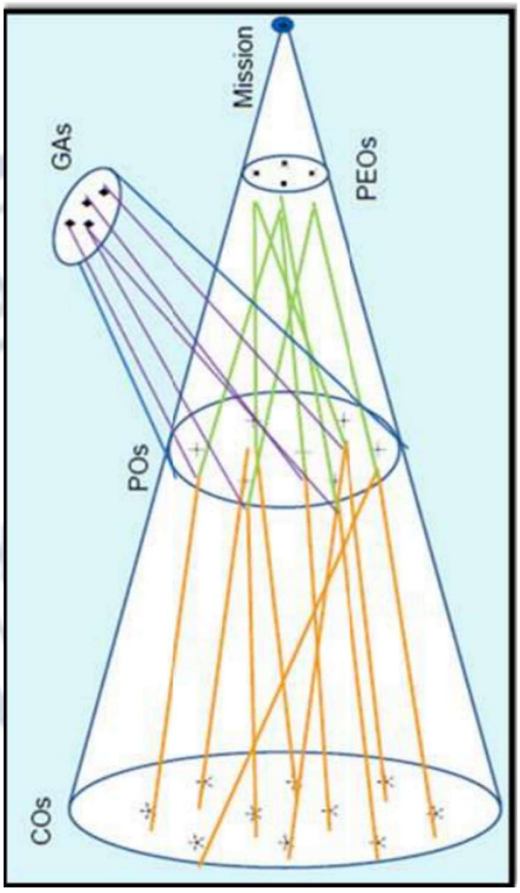
PSO1: Acquire and use adequate knowledge in Electronics and Communication engineering to fulfill societal needs.

PSO2: fundamental knowledge of communication engineering to design and develop electronics and communication systems to cater the needs of the industry.

7.Mechanical Engineering

PSO1: To design and manufacture the components and system as per requirement.

PSO2: To apply his knowledge in thermal science and management practice as a professional or entrepreneur.



9. CO-PO Attainment

9.1 CO-PO Matrix

AT present, we at DYPCET have implemented two approaches for establishing CO-PO mapping.

1. CO-PO matrix depending upon the contact hours
2. CO-PO matrix depending upon AICTE Examination Reform Policy, Nov. 2018

From academic year 2024-25, we use CO-PO matrix depending upon AICTE examination reform policy to correlate COs with PO with following two steps.

9.2 Two Step Process for Bringing Clarity to POs

Program Outcomes give useful guidance at program level for the curriculum design, delivery and assessment of student learning. However, they represent fairly high-level generic goals that are not directly measurable. A real observability and measurability of the POs at course level is very difficult. To connect high-level learning outcomes (POs) with course content, course outcomes and assessment, there is a necessity to bring further clarity and specificity to the program outcomes. This can be achieved through the following two-step process of identifying Competencies and Performance Indicators (PI).

Step-1: Identify Competencies to be attained

For each PO define competencies, which are different abilities implied by the program outcomes statement that generally require different assessment measure. This helps us to create a shared understanding of the competencies. We want students to achieve. They serve as an intermediate step to the creation of measurable indicators.

Example: 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)

Competencies

5.1 Demonstrate an ability to identify/ create modern engineering tools, techniques and resources

5.2 Demonstrate an ability to select and apply discipline specific tools, techniques and resources

5.3 Demonstrate an ability to evaluate the suitability and limitations of tools used

to solve an engineering problem

Step-2: Define Performance Indicators (PI)

For each identified competency, define performance indicators that explicitly state student learning expectations. They can act as measuring tools in assessment to understand the extent of attainment of outcomes. They can also be designed to determine the appropriate achievement level or competency of each indicator, so that faculty member can target student and help them to achieve an acceptable level of proficiency.

Example: Competency:

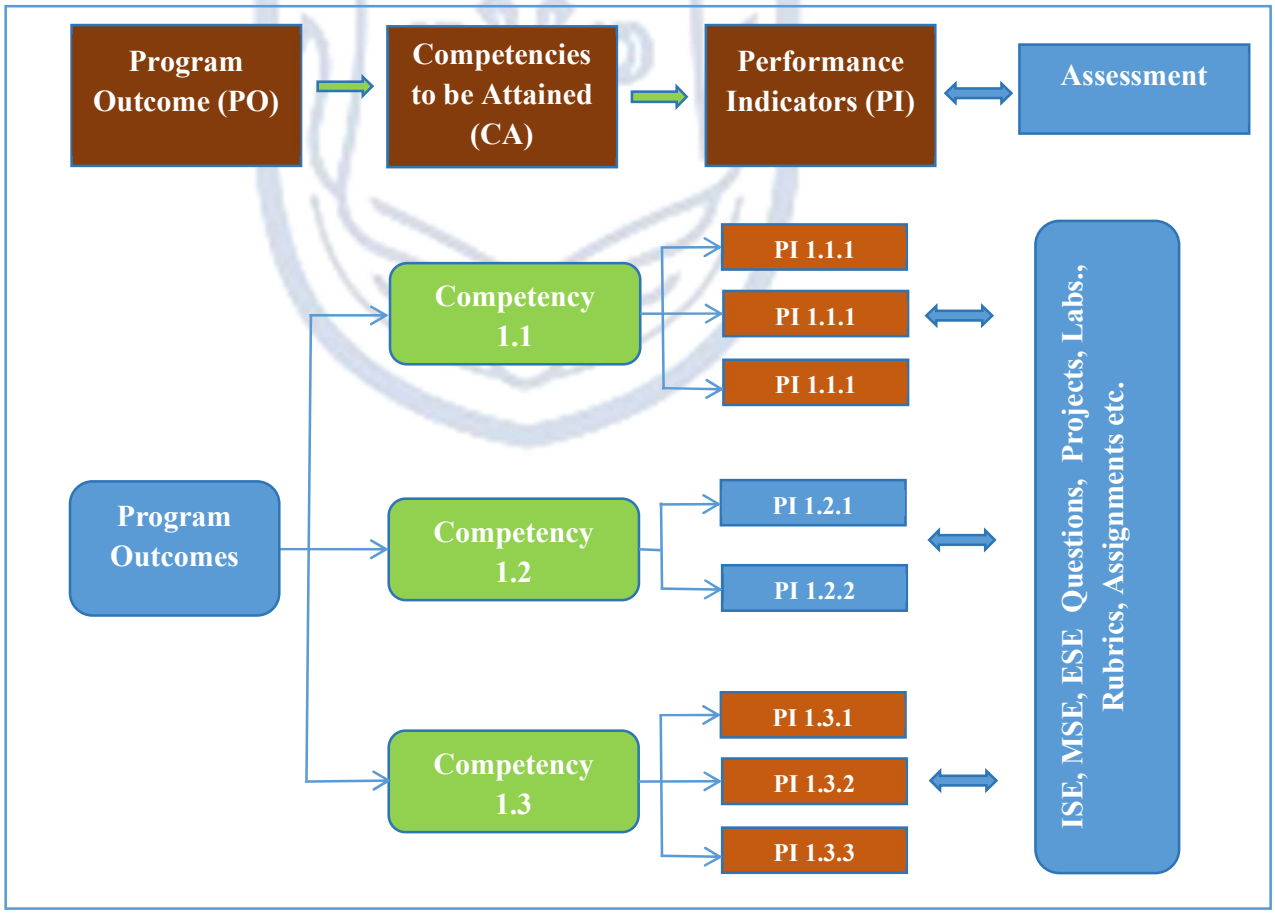
5.1 Demonstrate an ability to identify/ create modern engineering tools, techniques and resources

Indicators:

5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities

5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems

9.3 Connecting POs to Assessment



Program Outcomes-Competencies-Performance Indicators

Sr. No	1	2	3	4	5	6	7	8	9	10	11	12	Total
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	12
Competencies	04	04	04	03	03	02	02	02	03	03	03	03	36
Performance Indicators	05	13	13	10	06	02	04	03	07	07	05	06	81

9.4 Program Outcomes – Competencies – Performance Indicators

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.	
Competency	**Indicators**
1.1 Demonstrate competence in mathematical modelling	1.1.1Apply 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 science 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
PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
Competency	**Indicators**
2.1 Demonstrate an ability to identify and formulate complex	2.1.1 Articulate problem statements and identify objectives 2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 a given problem Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into interconnected sub-problems 2.2.2 Identify, assemble and evaluate information and resources. 2.2.3 forming justified approximations and assumptions

	Identify existing processes/solution methods for solving the problem, including 2.2.4 Compare and contrast alternative solution processes to select the best process.
2.3 Demonstrate an ability to formulate and interpret a model	2.3.1 Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy. 2.3.2 Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4 Demonstrate an ability to execute a solution process and analyze results	2.4.1 Apply engineering mathematics and computations to solve mathematical models 2.4.2 Produce and validate results through skillful use of contemporary engineering tools and models 2.4.3 Identify sources of error in the solution process, and limitations of the solution. 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.	
Competency	**Indicators**
3.1 Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1 Recognize that need analysis is key to good problem definition 3.1.2 Elicit and document, engineering requirements from stakeholders 3.1.3 Synthesize engineering requirements from a review of the state-of-the-art 3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE. 3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues 3.1.6 Determine design objectives, functional requirements and arrive at specifications
3.2 Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions 3.2.2 Build models/prototypes to develop a diverse set of design solutions 3.2.3 Identify suitable criteria for the evaluation of alternate design solutions
3.3 Demonstrate an ability	3.3.1 Apply formal decision-making tools to select optimal

to select an optimal design scheme for further development	engineering design solutions for further development 3.3.2 Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4 Demonstrate an ability to advance an engineering design to defined end state	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources) 3.4.2 Generate information through appropriate tests to improve or revise the design

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency	Indicators
4.1 Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 physical quantities Apply appropriate instrumentation and/or software tools to make measurements of 4.1.4 Establish a relationship between measured data and underlying physical principles.
4.2 Demonstrate an ability to design experiments to solve open-ended problems	4.2.1 Design and develop an experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3 Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 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.

Competency	Indicators
5.1 Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities 5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems

5.2 Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.2.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. 5.2.2 Demonstrate proficiency in using discipline-specific tools
5.3 Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1 Discuss limitations and validate tools, techniques and resources 5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	
Competency	**Indicators**
6.1 Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2 Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public
PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.	
Competency	**Indicators**
7.1 Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity 7.1.2 Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2 Demonstrate an ability to apply principles of sustainable design and development	7.2.1 Describe management techniques for sustainable development 7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
PO 8- Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)	
Competency	**Indicators**

8.1 Demonstrate an ability to recognize ethical dilemmas	8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.2 Demonstrate an ability to apply the Code of Ethics	8.2.1 Identify tenets of the ASME professional code of ethics 8.2.2 Examine and apply moral & ethical principles to known case studies
PO 9- Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams	
Competency	**Indicators**
9.1 Demonstrate an ability to form a team and define a role for each member	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2 Demonstrate effective individual and team operations--communication, problem solving, conflict resolution and leadership skills	9.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.2.2 Treat other team members respectfully 9.2.3 Listen to other members 9.2.4 Maintain composure in difficult situations
9.3 Demonstrate success in a team-based project	9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts
PO10- 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	
Competency	**Indicators**
10.1 Demonstrate an ability to comprehend technical literature and document project work	10.1.1 Read, understand and interpret technical and non-technical information 10.1.2 Produce clear, well-constructed, and well-supported written engineering documents 10.1.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2Demonstrate competence in listening, speaking, and presentation	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others 10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3 Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation
PO 11- 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	

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.
PO 12- 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)	
Competency	**Indicators**
12.1 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1 Describe the rationale for the requirement for continuing professional development 12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3 Demonstrate an ability to identify and access sources for new information	12.3.1 Source and comprehend technical literature and other credible sources of information 12.3.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Following tables gives the suggestive list of competencies and associated performance indicators. The above table can be used for most of the engineering programs. However, if requires some program may modify it.

9.4 Sample CO-PO Mapping with PI

Program: Mechanical Engineering

Course Code: 241MEBSCL104

Course Title: Physics for Mechanical Engineering

Teaching Scheme: L-T-P :03-00-00

Evaluation Scheme: ISE-I/MSE/ISE-II: 10/30/10

CO	Statements
104.1	**Explain** elastical analysis of materials for engineering applications
104.2	**Use** the classical mechanics for moment diagrams
104.3	**Apply** the fluid flow mechanics for liquids
104.4	**Apply** laws of mechanics for system of motions of bodies
104.5	**Identify** the physical parts of the DC machines
104.6	**Describe** electronic devices using electromagnetic induction law

For mapping COs with POs and PSOs, Course coordinator, Program Coordinator and HoD discussion/Brainstorming sessions and identifies the competency and performance indicators for all POs and PSOs

9.6 Sample Mapping judgement by the Course Coordinator

Sample Mapping judgement by the course coordinator (CO-PO-1)

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex	1.1	Demonstrate competence in mathematical modelling	1.1.1Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems	y	y	y	y	y	y
			1.1.2 Apply advanced mathematical techniques to model and solve engineering problems	y	y	y	y	y	y

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
engineering problems	1.2	Demonstrate competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problem	y	y	y	y	y	y
	1.3	Demonstrate competence in engineering fundamentals	1.3.1 Apply fundamental engineering concepts to solve engineering problems	y	y	y	y	y	y
	1.4	Demonstrate competence in specialized engineering knowledge to the program	**1.4.1 Apply Computer engineering concepts to solve engineering problems.**	--	--	--	--	--	--
PO1				**3**	**3**	**3**	**3**	**3**	**3**

Sample Mapping judgement by the course coordinator (CO-PO-2)

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with	2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1 Articulate problem statements and identify objectives	y	y	y	y	y	y
			2.1.2 Identify engineering systems, variables, and parameters to solve the problems	y	y	y	y	y	y
			2.1.3 Identify the mathematical, engineering and other relevant knowledge	y	y	y	y	y	y

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
consideration for sustainable development. (WK1 to WK4)			that applies to a given problem						
	2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into interconnected sub-problems	y	y	y	y	y	y
			2.2.2 Identify, assemble and evaluate information and resources.	--	--	--	--	--	--
			2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions	--	--	--	--	--	--
			2.2.4 Compare and contrast alternative solution processes to select the best process.	--	--	--	--	--	--
	2.3	Demonstrate an ability to formulate and interpret a model	2.3.1 Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.	--	--	--	--	--	--
			2.3.2 Identify	y	y	y	y	y	y

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
			assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.						
	2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1 Apply engineering mathematics and computations to solve mathematical models	--	--	--	--	--	--
			2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models	y	y	y	y	y	y
			2.4.3 Identify sources of error in the solution process, and limitations of the solution.	--	--	--	--	--	--
			2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis	--	--	--	--	--	--
			PO2	**2**	**2**	**2**	**2**	**1**	**1**

Sample Mapping judgement by the course coordinator (CO-PO-8)

Program Outcome	Competency	Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams	8.1	Demonstrate an ability to form a team and define a role for each member	8.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team	--	--	--	--	--	--
			81.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.	--	--	--	--	y	y
	8.2	Demonstrate effective individual and team operations-communication, problem solving, conflict resolving, and leadership skills	8.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills	--	--	--	--	--	--
			8.2.2 Treat other team members respectfully	--	--	--	--	y	y
			8.2.3 Listen to other members	--	--	--	--	y	y
			8.2.4 Maintain composure in difficult situations	--	--	--	--	--	--
	8.3	Demonstrate success in a team based project	8.3.1 Present results as a team, with smooth integration of contributions	--	--	--	--	--	--

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
			from all individual efforts						
PO8				0	0	0	0	1	1

Sample Mapping judgement by the course coordinator (CO-PO-11)

Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
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			11.1.1 Describe the rationale for the requirement for continuing professional development	--	--	--	--	--	--
	11.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	11.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap	--	--	--	--	--	--
	11.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	11.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current	--	--	--	--	--	--
			11.2.1 Recognize the need and be able to clearly explain why it is	y	y	y	y	y	y

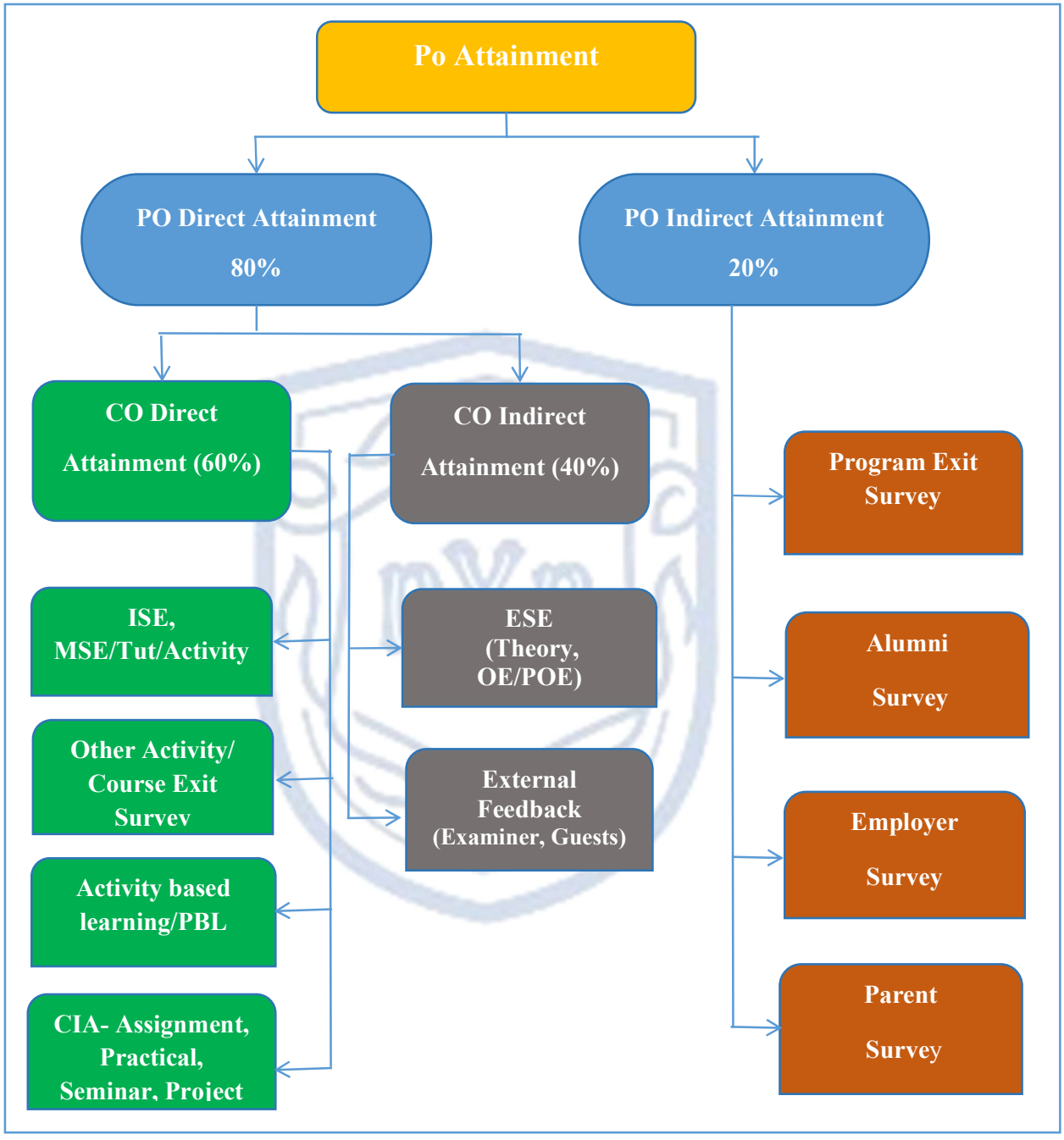
Program Outcome	Competency		Performance Indicator	CO1	CO2	CO3	CO4	CO5	CO6
			vitally important to keep current regarding new developments in your field						
	11.3	Demonstrate an ability to identify and access source for new information	11.3.1 Source and comprehend technical literature and other credible sources of information	--	--	--	--	--	--
			11.3.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.	--	--	--	--	--	--
PO11				**1**	**1**	**1**	**1**	**1**	**1**

9.7 Sample CO-PO Matrix

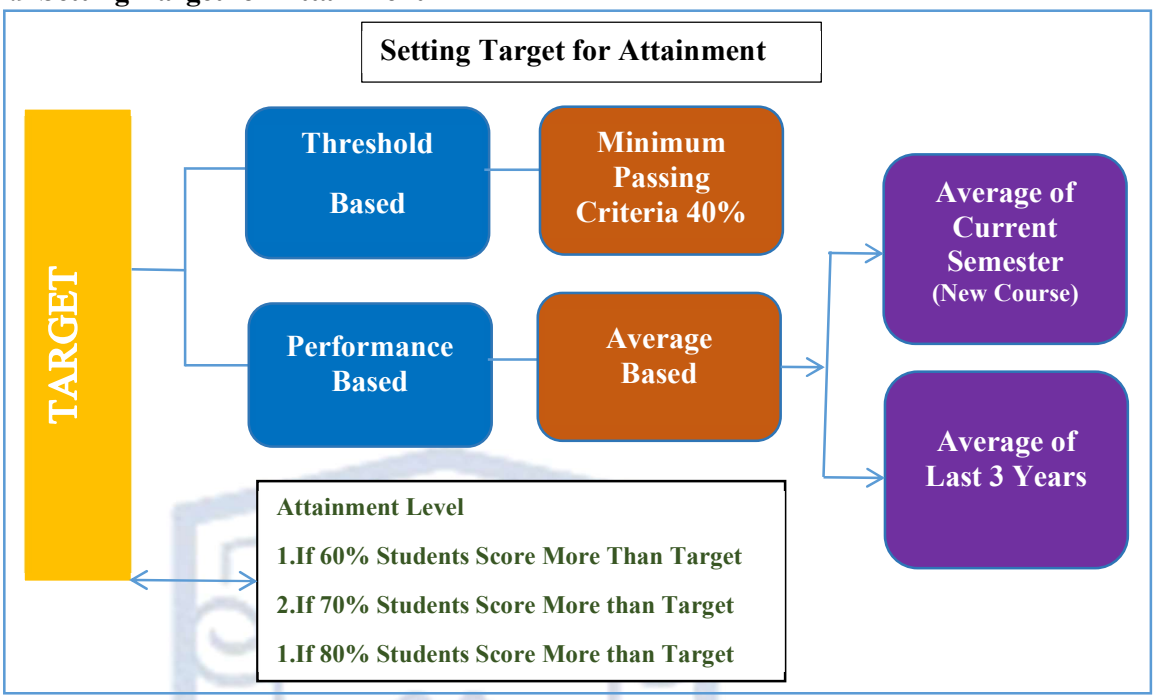
For The Course: 241MEBSCL104 Physics for Mechanical Engineering

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	--	--	--	--	--	--	--	--	1
CO2	3	2	--	--	--	--	--	--	--	--	1
CO3	3	2	--	--	--	--	--	--	--	--	1
CO4	3	2	--	--	--	--	--	--	--	--	1
CO5	3	1	--	--	--	--	--	1	--	--	1
CO6	3	1	--	--	--	--	--	1	--	--	1
Average	**3**	**1.66**	--	--	--	--	--	**1**	--	--	**1**

9.8 PO Attainment Flow Chart



9.9 Setting Target for Attainment



9.10 CO Attainment Calculations

Attainment Weightage

Consider following weightage for PO assessment tools

PO Assessment Tools	
Direct PO Assessment (80%)	**Indirect PO Assessment (20%)**

Consider following weightage for CO assessment tools

PO Direct Assessment Tools	
Direct CO Assessment	**Indirect CO Assessment**
60	40
50	50

Equal distribution to all assessment tools, Assessment $= \sum_{i=1}^{n} WiAi$

Where W= Weightage of Assessment Tool, A= Attainment of CO

Note: Appropriate % weightage distribution may be considered for any number of direct/indirect assessment tools with proper justification at department/faculty level

Illustration of MSE examination attainment

Course Title	Numerical Techniques
Maximum Marks	30
Number of Students Appeared	60
Passing Level (Threshold Based Target)	12 (40%)

Now, we need Target (mentioned in above table) and marks of all 60 students to calculate attainment. The table below shows marks of all students

5	23	5	11	21	0
0	12	5	2	7	4
0	22	3	3	10	7
5	18	9	20	17	24
23	8	25	16	9	10
12	2	8	11	22	4
26	13	2	1	30	19
24	22	16	10	1	2
12	21	8	25	11	4
24	9	22	20	20	17

Now

Number of students achieving 12 or more marks	28
% of students achieving 12 or more marks	(28/60)*100 = 46.6%

Let's say my Attainment levels are

1 – If 40 % students score more than target

2 – If 50 % students score more than target

3 – If 60 % students score more than target

Then attainment is 1 (for 46.6%)

Illustration of feedback/rubric-based assessment & attainment

Course Title	Building Construction
Maximum Marks	5
Number of Students Appeared	60
Passing level (Average Based Target)	3 (>50%)

Now, we need Target (mentioned in above table) and response/feedback of all 60 students to calculate attainment. The table below shows score/response of all students

4	3	3	1	2	5
3	3	2	1	2	4
4	2	5	5	1	5
1	1	5	2	2	4
2	2	5	3	5	1
2	4	2	5	2	1
3	4	4	2	4	3
5	2	4	3	2	5
5	5	4	4	4	2
5	4	4	2	3	5

Now

Number of Student giving 3 or more score	37
% of students with 3 or more marks	(37/60)*100 = 61.7%

Let's say my Attainment levels are

1 – If 40 % students score more than target

2 – If 50 % students score more than target

3 – If 60 % students score more than target

Then attainment is 3(for 61.7%)

9.11 Overall Attainment of CO

Let's assume CO1 is assessed using any 2 direct + 2 Indirect CO assessment tools

Then

Overall CO Attainment = (Weightage x Direct CO attainment)
+ (Weightage x Indirect CO attainment)

Overall CO Attainment = (60 % x Direct CO attainment)
+ (40% x Indirect CO attainment)

OR

Equal distribution to all assessment tools, Assessment = $\sum_{i=1}^{n} WiAi$

Where W= Weightage of Assessment Tool, A= Attainment of CO

Note: Appropriate % weightage distribution may be considered for any number of direct/indirect assessment tools with proper justification at department/faculty level

9.12 Contribution of Course Attainment in PO Attainment

Illustration

Lets assume CO-PO mapping of course

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2	1	-	-	-	-	-	-	-	-	-	3	-	-
3	-	3	1	-	-	-	-	-	-	-	-	-	3	-	-
4	-	3	-	2	-	-	-	-	-	-	-	1	3	-	-
Average	3	3	1	2	-	-	-	-	-	-	-	1	3	-	-

Overall Attainment of CO is as below

CO	Direct Tool Attainment (A)	Indirect Tool Attainment (B)	Overall Attainment = 0.6 x A + 0.4 x B
1	2	3	2.8
2	3	3	3
3	2	3	2.8
4	1	3	2.6

Hence, final contribution of CO attainment in PO attainment can be derived using the formula,
CO Contribution = Overall CO attainment X (CO-PO Mapping weightage / 3)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2.00	1.00	-	-	-	-	-	-	-	-	-	3.00	-	-
3	-	2.80	0.93	-	-	-	-	-	-	-	-	-	2.80	-	-
4	-	2.60	-	1.73	-	-	-	-	-	-	-	0.87	2.60	-	-
Average	2.80	2.50	0.96	1.73	-	-	-	-	-	-	-	0.86	2.80	-	-

Sample Calculations:

CO1- PO1 mapping attainment → 2.8 x 3/3 = 2.80 (up to 2 decimal places)

CO2- PO2 mapping attainment → 3 x 2/3 = 2.00

CO2- PO3 mapping attainment → 3 x 1/3 = 1.00

CO3- PO3 mapping attainment → 2.8 x 1/3 = 0.93

CO4- PO12 mapping attainment → 2.6 x 1/3 = 0.86

9.13 Continuous Improvement

In OBE, continuous improvement has prime importance.

Outcome	Action to be taken by faculty
All CO-PO **Attained Highly** (>2.50 out of 3)	Set new higher targets or attainment levels for next Academic Year

Outcome	Action to be taken by faculty
All CO-PO **Attained Moderately** (1.8 to 2.49 out of 3)	Record observations, Continue action plan of last Academic Year with plan for improvement
All CO-PO **Attained Lowly** (0.9 to 1.79 out of 3)	Record observations, assess the target set, revise/improve action plan of last Academic Year to achieve the attainment with plan for improvements
CO-PO **Not Attained,** poor performance (<0.90 out of 3)	Record observations, Critical assessment of target with PC/HoD, Revise action plan of last Academic Year at faculty/department level.

Note: Appropriate attainment levels can be varied as per difficulty level of course/ pre-defined by department while calculating CO-Po attainment

PO attainment and Continuous Improvement

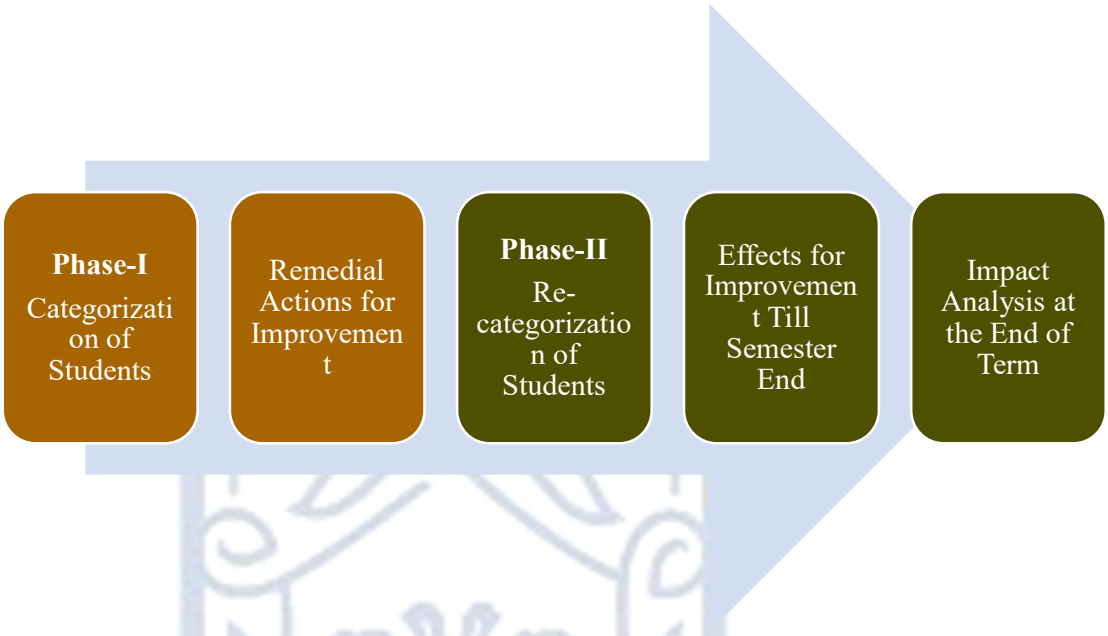
Category	Outcome	Action by PC or HoD
Course related	PO Highly Attained	Include activities with HOT
	PO Not Attained	Identify concerned courses, plan for immediate improvements, guide, support and monitor its execution
Activity related	Activities Completed	Critical assessment and impact analysis to be done

Illustration*:*

Case of Course	Avg % result in last year/ 3 years	Clue for keeping target	Attainment 1 if	Attainment 2 if	Attainment 3 if
Course 1	<40 %	Threshold	40 % cross target	50% cross target	60% cross target
Course 2	Above 40% but less than 50%	Threshold with high attainment level	60 % cross target	70% cross target	80% cross target
Course 3	Above 50 %	Average based	40 % cross target	50% cross target	60% cross target
Course 4	Above 80%	Average based with high attainment level	60 % cross target	70% cross target	80% cross target

10.Students Competency

10.1 Chart of Action Plan



10.2 Guidelines for First Year

Phase I- Categorization (After 15 Days of Start of Semester)	Phase II- Re-Categorization (After Mid Term Result)
12th Marks	Mid Term Result
Prerequisite Test	Timely Completion of Work
Surprise Test after 15 days	Lab Performance
Attendance & Behaviour	Attendance & Behaviour
	Previous Semester ESE Result (Applicable for Sem - II)

10.3 Guidelines for Higher Classes [S.Y., T.Y. & Final Year-B.E.]

Phase I- Categorization (After 15 Days of Start of Semester)	Phase II- Re-Categorization (After Mid Term Result)
Previous semester ESE Result whichever is available	Mid Term Result
Prerequisite Test	Timely Completion of work
Surprise Test after 15 days	Lab Performance
Attendance & Behaviour	Attendance & Behaviour
	Previous Semester ESE Result

10.4 Base Score for student category (Sample)

<40%	-	Slow Learner
40% to 90%	-	Average Learner
>90%	-	Advanced Learner

10.5 Strategies for Slow, Average and advanced Learners

For Slow learners

- Document/record of remedial classes with timetable & attendance
- Specially designed assignment/ task
- Student study group for peer to peer learning
- Individual Counseling
- Student help desk

Note: Remedial sessions should be conducted once every week

For Average learners

- Additional assignment/ task
- Encouraging for timely and effective completion of work
- Conduction of quiz, orals etc.
- Solving previous year ESE question papers and test papers
- Presentation on technical topics/ case studies/mini projects

Note: Activities should be on continuous basis

For Advanced learners

- Encouraging to present & publish papers in journals/conferences/competitions
- Guidance for GATE/ competitive Examination
- Encouraging to participate in professional activities.
- Special designed activities to improve the portfolio of students.
- Special guidance for career building

Note: Activities should be on continuous basis

10.6 First Year Student Competency Rubric

D. Y. Patil College of Engineering Technology
(An Autonomous Institute)
Student Competency: Academically Slow Learners, Average Learners and Advance Learners

Department of First Year Engineering	**Academic Year:** 20… - 20…	**Sem-**
Branch:	**Div:**	
Faculty Name:	**Course Name:**	**Code:**

Advance Learners (ADL): 90% and above, Average Learners(AVL):40% -89% , Slow Learners (SL): Less than 40%

Roll No	Unique ID	Student Name	Basic Proficiency Test	Status	ISE-1	Status	MSE	Status	ISE-II	Status	ESE	Status	BASIC	ISE-1	MSE	ISE-II	ESE	Total	General Approach
Report				Basic Proficiency Test		ISE-1		MSE		ISE-II		ESE							
No of students-Slow Learners																			
No of Students- Average Learners																			
No of students- Advance Learners																			

Action Taken Against Slow Learners (ISE-I):	Action Taken Against advance Learners (ISE-I):
Action Taken Against Slow Learners (MSE):	Action Taken Against advance Learners (MSE):
Action Taken Against Slow Learners (ISE-II):	Action Taken Against advance Learners (ISE-II):

11.Assessment Tools

11.1 Tools for Direct and Indirect Assessment Methods

Assessment methods are tools and techniques used to determine the extent to which the stated Course Outcomes are achieved. A variety of methods, qualitative and quantitative, direct and indirect, should be used. The following are examples of direct and indirect assessment methods:

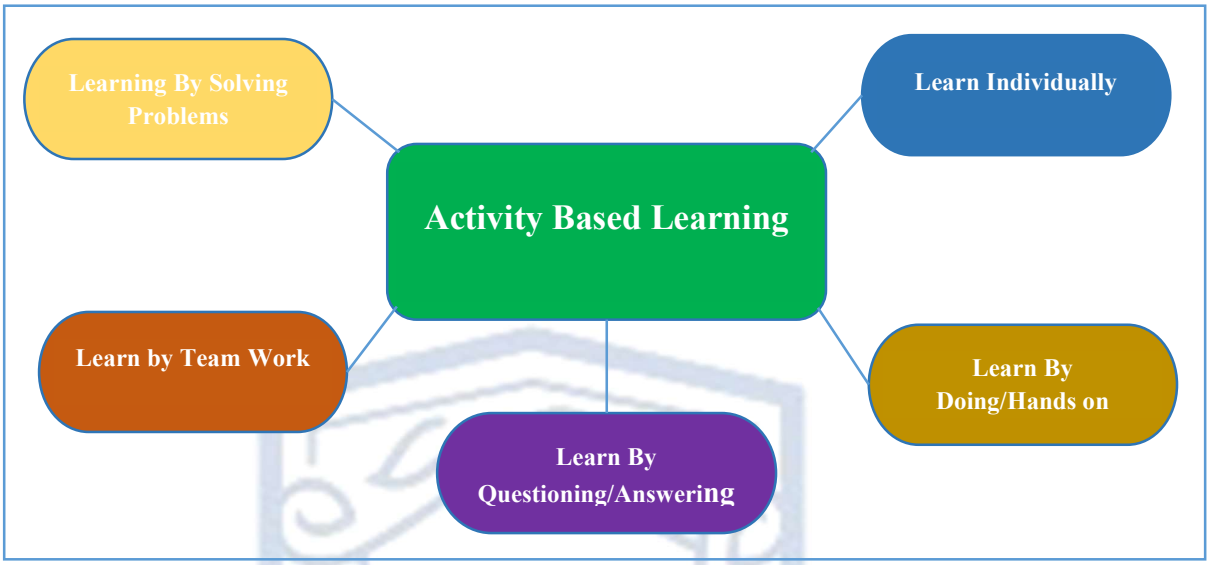
Direct Assessment Methods	Indirect Assessment Methods
ISE-I & ISE-II	Course Exit Survey
MSE	Industrial Visit
ESE	Alumni Survey
Continuous Assessment Sheet	Employer surveys
Practical Oral Examination/Oral	Program Exit Survey

11.2 Sample CO Assessment Tools

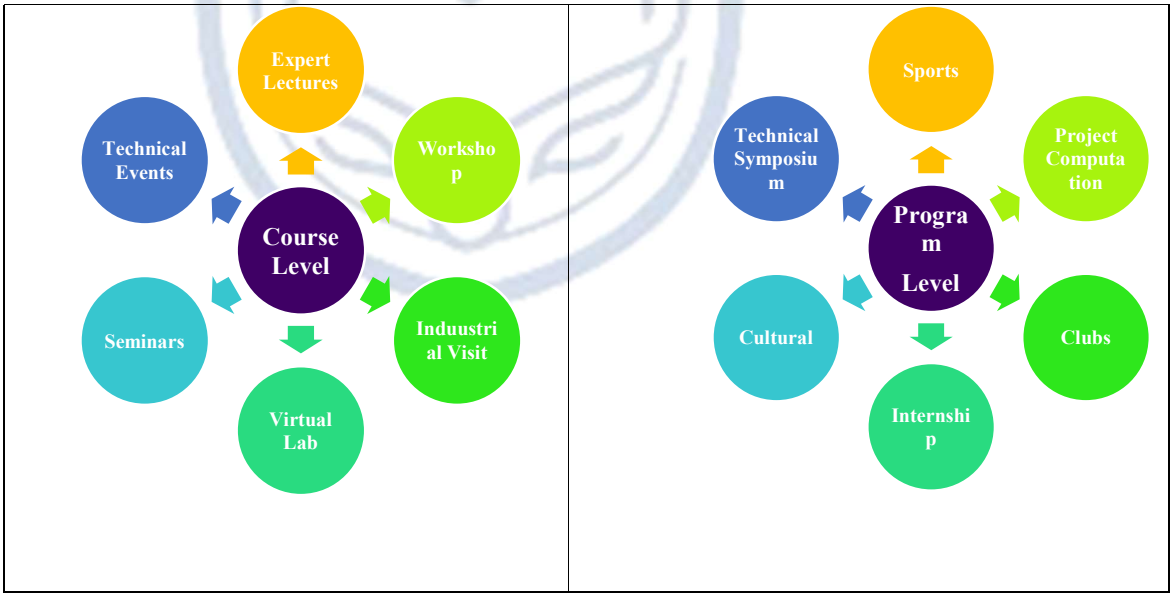
ISE- Quiz, Assignment, MCQ, Poster presentation, Video making, Group discussion, PPT presentation, Model making, Case study, Chart making, Open Book Test, Report writing, Competition, seminar, Think pair share, Flipped classroom, Collaborative learning, jigsaw puzzle method, Matrix method, Peer-learning, Work-based Learning, Problem-based Learning, Personalized Learning ,Audio Visual Aids, Technical quiz, Brain Storming, Pole Play, Technical Debate, PPT, NPTEL, Hackathons, MOOCs, Google Classroom, Virtual Lab, Real Time case studies, Simulation, Kahoot, Mind map, Demonstration, Pogil, Open Book Test, Proto-Type model, Plicker etc.

- MSE- Descriptive Examination
- ESE- Descriptive Examination
- Continuous Assessment Sheet
- Practical Oral Examination/Oral
- Course Exit Survey
- Guest Lectures
- Workshop, Industrial Visit
- Rubrics
- Project

12.Activity Based Learning



13. CO Attainment and Gap Analysis



The Institute has initiated the following measures to bridge the identified curricular gaps.

1.Guest lectures: Experts from industry and academia are invited to deliver lectures on the latest trends and thrust areas in Computer Engineering.

2. **Technical talk:** Students are kept updated about the advances in technologies through technical seminars.

3.**Workshops & Training Programs:** The Department has introduced a novel initiative for students, wherein they are encouraged to participate in hands-on workshops, and project training programs, thereby enhancing their application skills.

4.**Soft Skill Training**: The department emphasizes personality development through soft skills training programs to improve the employability of students.

5.**Industrial visits:** Visits to industries of repute are organized every year to keep the students abreast with applications of Computer Science and Engineering.

6.**Internships**: Students are encouraged to take up short-term internships in industries and recognized R&D centers to understand industry practices.

7.Mini Projects: Students can obtain practical experience by completing mini-Projects. It is a group activity in which a group of students works on a specific problem statement in the engineering domain to gain problem-solving experience using the information and resources available and under the guidance of a course coordinator.

8.**Technical Competitions & Conferences:** Various competitions and technical events, such as project competitions, quizzes, coding competitions, and international conferences, are organized by the department.

9. **Extra Classes to bridge course Gap/Topic Gap:** Extra lectures are conducted by faculty members to bridge the course and topic gaps, and to ensure that the curricula are covered by the Pos.

Bridge the Knowledge Gap

The knowledge gap is identified by Focus Group and addressed at five levels throughout the course.

1. **Prerequisite level of course**: This is the fundamental knowledge required before the commencement of the course. The first lecture is the overview of the course contents and focuses on the prerequisite to understand subsequent concepts.

2. **Gap within the unit:** This is knowledge required for understanding the unit. The faculty member provides additional knowledge (if required) for thorough under standing of the concepts through online course and reference materials. Innovative teaching practices like quizzes and role play are conducted

3. **Gap within the course:** This is the knowledge required for transition from one unit to other. Variety of topics is covered under a single course. So, additional knowledge is imparted for linking of units.

4**. Domain Gap** : It bridges the gap between courses and engineering practices/ processes which is not addressed in the syllabus. The department conducts various expert lectures, session, workshops through experts from academics as well as industry to bridge the gap. Expert sessions are organized on various topics covering inventions, innovations and research articles.

5. **Societal need or further challenges:** The social needs, environmental concerns for sustainable solution, recent trends in tools and technologies is addressed. Social/field visits/ Guest Lectures are conducted to create awareness about upcoming challenges in the field and sensitizing them about the social needs.

Apart from addressing the gaps in curriculum, additional activities are conducted at course level and program level to address program outcomes.

14. Assessing Higher Order Abilities & Professional Skills

Source: AICTE Examination Reform Policy Nov.2018

In the 21st century, professional skills (also known as soft skills, generic skills or transferable skills) have emerged as important attributes of a graduate engineer. Studies show that Industry/ employers around the world value these abilities more than the disciplinary knowledge. This is also reflected in the NBA graduate attributes wherein six out of twelve attributes belong to this category, viz. (1) communication, (2) teamwork, (3) understanding ethics and professionalism, (4) understanding global and societal contexts, (5) lifelong learning, and (6) knowledge of contemporary issues. Further, higher-order cognitive abilities like critical thinking, problem-solving and making informed decisions are also crucial for a graduate to succeed in the

emerging world. Though the employers consider these professional skills and higher abilities as important, students are weak in them. The main challenge surrounding them is that they are difficult to assess through existing conventional examination system.

14.1 Innovative Educational Experiences to Teach and Assess

Following are the few educational experiences that are recommended to teach and assess professional outcomes and higher-order cognitive abilities:

- Course projects
- Open-ended experiments in laboratories
- Project-based learning modules
- MOOCs
- Co-curricular experiences
- Mini / Minor projects
- Final year projects
- Internship experiences
- E-portfolios of student works

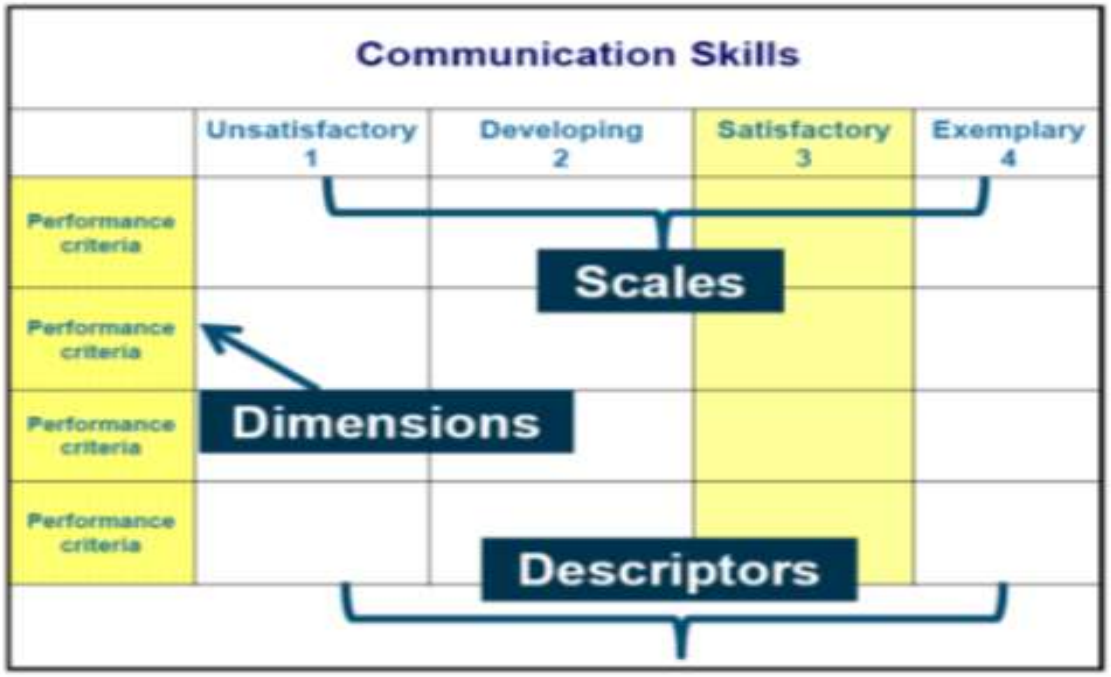
14.2 Using Scoring Rubrics as Assessment Tool

Rubrics provide a powerful tool for assessment and grading of student work. They can also serve as a transparent and inspiring guide to learning. Rubrics are scoring, or grading tool used to measure a students' performance and learning across a set of criteria and objectives. Rubrics communicate to students (and to other markers) your expectations in the assessment, and what you consider important.

There are three components within rubrics namely

(i) criteria / performance Indicator: the aspects of performance that will be assessed,
(ii) descriptors: characteristics that are associated with each dimension, and

(iii) scale/level of performance: a rating scale that defines students' level of mastery within each criterion.



14.3 Rubric for Communication (Written and Oral)

Component	Proficient	Acceptable	Needs Improvements
Written Communication	Report is well organized and clearly written. The underlying logic is clearly articulated and easy to follow. Words are chosen that precisely express the intended meaning and support reader comprehension. Diagrams or analyses enhance and clarify presentation of ideas. Sentences are grammatical and free from spelling errors.	Report is organized and clearly written for the most part. In some areas the logic or flow of ideas is difficult to follow. Words are well chosen with some minor exceptions. Diagrams are consistent with the text. Sentences are mostly grammatical and only a few spelling errors are present but they do not hinder the reader.	Report lacks an overall organization. Reader has to make considerable effort to understand the underlying logic and flow of ideas. Diagrams are absent or inconsistent with the text. Grammatical and spelling errors make it difficult for the reader to interpret the text in places.

Component	Proficient	Acceptable	Needs Improvements
Presentation Visual Aids	Slides are error-free and logically present the main components of the process and recommendations. Material is readable and the graphics highlight and support the main ideas.	Slides are error-free and logically present the main components of the process and recommendations. Material is mostly readable and graphics reiterate the main ideas.	Slides contain errors and lack a logical progression. Major aspects of the analysis or recommendations are absent. Diagrams or graphics are absent or confuse the audience.
Oral Presentation	Speakers are audible and fluent on their topic, and do not rely on notes to present or respond. Speakers respond accurately and appropriately to audience questions and comments.	Speakers are mostly audible and fluent on their topic, and require minimal referral to notes. Speakers respond to most questions accurately and appropriately	Speakers are often inaudible or hesitant, often speaking in incomplete sentences. Speakers rely heavily on notes. Speakers have difficulty responding clearly and accurately to audience questions.
Body Language	Body language, as indicated by appropriate and meaningful gestures (e.g., drawing hands inward to convey contraction, moving arms up to convey lift, etc.) eye contact with audience, and movement, demonstrates a high level of comfort and connection with the audience.	Body language, as indicated by a slight tendency to repetitive and distracting gestures (e.g., tapping a pen, wringing hands, waving arms, clenching fists, etc.) and breaking eye contact with audience, demonstrates a slight discomfort with the audience.	Body language, as indicated by frequent, repetitive and distracting gestures, little or no audience eye contact, and /or stiff posture and movement, indicate a high degree of discomfort interacting with audience.

14.4 Rubric for Mini Project

GA: Group Assessment, **IA:** Individual Assessment

Review-I

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
2.1.1	Articulate Problem statements and identify objectives - GA	02	Problem statement and objectives are not identified	Problem statement and objectives are not clear	Problem statement is clear and objectives are not in line with problem statement	Problem statement is clear and objectives are not completely defined.	Problem statement is clear and objectives are completely defined
2.1.2	Identify engineering systems, variables, and parameters to solve the problems - IA	02	Engineering systems are not identified. Variables, and parameters to solve the problems are not defined	Engineering systems are identified but not clear. Variables, and parameters to solve the problems are not defined	Engineering systems are clear. Variables and parameters to solve the problems are not defined	Engineering systems are identified Variables and parameters to solve the problems are partially defined	Engineering systems are identified. Variables, and parameters to solve the problems are completely defined
2.2.3	Identify existing processes/ solution methods for solving the problem, including forming	02	Not able to identify existing solution for solving the problem. The assumptio	Not able to identify existing solution for solving the problem. The assumptio	Not able to identify existing solution for solving the problem. But assumpti	Able to identify existing solution for solving the problem. Assumptions, and approxim	Able to identify existing solution for solving the problem. But assumptions, approximations and

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
	justified approximations and assumptions - GA		ns, approximations and justifications are also not identified.	ns, approximations and justifications are identified but not clear	ons and approximations are aligned to the objectives.	ations are clear	justifications are clear
2.2.4	Compare and contrast alternative solution processes to select the best process - GA	02	Not able to identify alternative solution processes	Not able to compare alternative solution processes	Able to compare alternative solution processes but could not contrast clearly	Able to compare alternative solution processes and contrast clearly but not able to select best process	Able to compare alternative solution processes, contrast it and also able to select best process
10.1.1	Read, understand and interpret technical and non-technical information - GA	02	Not able to identify technical and non-technical information	Able to identify non-technical information	Able to read technical and non-technical information, but could not understand and interpret	Able to read, understand technical and non-technical information, but could not interpret	Able to read, understand and interpret technical and non-technical information

Review-II

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions - GA	02	Not able to identify tools to develop solutions	Able to identify but not able to use it effectively	Able to use the tool but not able to generate engineering designs	Able to generate engineering designs but not able to justify	Able to generate engineering designs with justification
3.2.3	Identify suitable criteria for evaluation of alternate design solutions - GA	02	Not able to identify criteria	Able to identify criteria but not able to use them	Able to use criteria but not able to compare alternatives	Not able to justify the comparison with criteria	Able to justify the comparison with criteria
3.3.1	Apply formal decision making tools to select optimal engineering design solutions for further development - GA	02	Not able to identify decision-making tools	Able to identify but not able to choose optimum one	Able to identify optimum one but not able to use it	Able to use optimum one but not able to justify	Able to use optimum one with justification
3.2.2	Build models/ prototypes to	02	Not able to identify tool to build	Able to choose the tool but not	Able to use the tool but not able	Able to generate alternatives	Able to generate and justify the best

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
	develop diverse set of design solutions - IA		model/ prototype	able to use it effectively	to generate alternatives	but not able to justify the best solution	solution
13.1.1	Develop 2D drawings of components/ systems using modern CAD tools - IA	02	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate drawings	Able to generate drawings but not able to follow drawing standards	Able to generate drawings with standards
13.1.2	Develop 3D models of components/systems using modern CAD tools - IA	03	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate 3D models	Able to generate models but not able to follow standards	Able to generate models with standards
13.1.3	Apply GD&T principles as per ASME standards manufacturing drawings, with all relevant data like material, hardness,	02	Not able to extract GD&T principles from ASME standards	Able to extract but not able to understand them	Able to understand but not able to apply GD&T standards	Able to apply GD&T standards to drawings but not able to justify	Able to apply and justify GD&T standards to drawings

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
	surface finish, and tolerances - IA						

Review-III

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
3.4.2	Generate information through appropriate tests to improve or revise design - GA	02	Not able to identify suitable tests to be done	Able to identify but not able to follow testing procedure	Able to follow testing procedures but not able to collect information	Able to collect information but not able to apply it for improvement	Able to apply information for the improvement
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data - GA	04	Not able to identify tools, techniques and procedures	Able to identify but not able to conduct experiments	Able to conduct experiments but not able to follow procedure	Able to follow procedure but not able to collect data	Able to collect data as per the standards
4.3.2	Analyze data for trends and	03	Not able to understand data	Able to understand but not able to	Able to analyze data but not able	Able to correlate but not able to	Able to identify errors and limitations

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
	correlations, stating possible errors and limitations - GA			analyze data	to correlate them	identify errors and limitations	
10.2.2	Deliver effective oral presentations to technical and non technical audiences - IA	03	Could not deliver effective presentations.	Could not deliver presentation, but presentation was prepared and attempted	Able to deliver fair presentation but not able to answer to the audiences	Deliver effective presentations but able to answer partially to the audience queries.	Deliver effective presentation and able to answer all queries of the audience.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts – GA + IA	03	No Contribution from an individual to a team	Contributions from an individual to a team is minima	Contributions from an individual to a team is moderate	A contribution from an individual to a team is good but not well groomed in team.	Contribution from an individual to a team is good and results in an integrated team presentation.

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY

KASABA BAWADA KOLHAPUR-416006

(An Autonomous Institute)

Department of …… Engineering

Course File/Personal File etc.

Course Name: …….

Course Code:……

Class: F. Y. B. Tech. **Div:…….**

Program: ……..

Prepared By

Dr./MR/MS/MRS/……

Assistant Professor

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3.	Qualification Proofs- Ph. D, PG, UG, HSC/Diploma, SSC (Mark Sheets and Certificates)
4.	Additional Qualification Proofs (if any)
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7.	Initial Appointment Letter and Joining Letter
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19.	Copy of Sponsorship Letter if Sponsored for PG/Ph.D, Post-Doctoral
20.	Proofs of Membership of Professional Bodies/Societies
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Thank You