Outcome Based Education manual

Department of Electrical Engineering

Vision and Mission of the Institute

Vision of the Institute

"To Achieve Excellence in Engineering and Management Education"

Mission of the Institute

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

Vision and Mission of the Department

Vision

To develop Electrical Engineering Department as one of the premier facility centre for disseminating the state of the art education.

Mission

- Providing Quality education in the field of Electrical Engineering.
- Developing State of the art facilities in the department.
- Creating platform for Training, Research and Development.
- Producing Sound Electrical Engineers Catering need of industry and other stake holders.

1. Introduction

1.1 About Pune Vidyarthi Griha

The parent institute Pune Vidyarthi Griha, formerly known, as Pune Anath Vidyarthi Griha is a well-known charitable institution of Maharashtra, established in 1909, by a group of dedicated and visionary educationists.

The primary mission of the Institute is to provide progressive and value added education facilities for the deserving, poor students of the society.

Today, the institution has grown with its branches at Pune- Sadashiv Peth Main Campus, Pune – Vidyanagari Campus, Mumbai – Ghatkopar Campus, Navi Mumbai – Nerul Campus, Nashik – Mhasrul Campus, and Nashik – Talegaon Anjaneri Campus. The Institute conducts a wide spectrum of education programs from Pre-primary to Higher education, in professional fields like Engineering, Technology, Management, Computer Science, and Commerce & Science College etc.

1.2 PVG's COET & M, Pune

PVG's College of Engineering, Technology and Management formerly known as PVG's COET & GKPIOM, was established in 1985 with pioneering branch of Printing Engineering. PVGCOET is affiliated Savitribai Phule Pune University, approved by AICTE and by Government of Maharashtra. The Institute is accredited by NAAC with Grade 'A". From 2025 Autonomy is granted to the college. Institute offer UG, PG and Ph.D. programs. The list of programs are given below.

The Institute is offering following UG Programs

Name of Program	Program Level	Year of Start	Initial Intake	Sanctioned Intake
Printing & Packaging Technology	UG	1985	60	60
Mechanical Engineering	UG	1991	60	120
Electrical Engineering	UG	1991	30	60
E&TC Engineering	UG	1991	30	120
Information Technology	UG	2001	60	60
Computer Engineering	UG	2002	60	60
Artificial Intelligence and Data Science	UG	2021	60	60

Post Graduate Course run by the institute

Name of Program	Program Level	Year of Start	Initial Intake	Sanctioned Intake
Electrical Power System	PG	2000	18	18
Printing & Packaging Technology	PG	2009	18	9
Masters of Business Administration	PG	2011	60	60

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

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

1.3 About Savitribai Phule Pune University

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

library containing plenty of books regarding various subjects. The university offers different scholarships to the students. The university conducts seminars and conferences for the students.

1.4 National Board of Accreditation (NBA)

The National Board of Accreditation (NBA), India was initially established by the AICTE (All India Council of Technical Education) under section 10(u) of AICTE Act, in the year 1994, in order to assess the qualitative competence of the programs offered by educational institution from diploma level to post-graduate level in engineering and technology, management, pharmacy, architecture and related disciplines, which are approved by AICTE.

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

1.5 National Assessment and Accreditation Council (NAAC)

The NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL (NAAC) conducts assessment and accreditation of Higher Educational Institutions (HEI) such as colleges, universities or other recognized institutions to derive an understanding of the 'Quality Status' of the institution. NAAC evaluates the institutions for its conformance to the standards of quality in terms of its performance related to the educational processes and outcomes, curriculum coverage, teaching-learning processes, faculty, research, infrastructure, learning resources, organization, governance, financial wellbeing and student services.

2. Outcome based Education

2.1 OBE Philosophy

Outcome-Based Education (OBE) is a student-centric, proactive philosophy focusing on what learners know and can do upon graduation rather than just content delivery. It utilizes a backward design to align curriculum, teaching, and assessment with specific, measurable, and real-world skills.

This model signifies a transformation in the educational paradigm, prioritizing learning outcomes over teaching processes. All educational activities conducted within an Outcome- Based Education (OBE) framework should assist students in reaching the established objectives. Faculty members may modify their roles to serve as instructors, trainers, facilitators, or mentors, depending on the desired outcomes. The OBE approach represents an ongoing educational process that involves the continual enhancement of the curriculum, teaching methodologies, and assessment instruments.

Key principles include high expectations, expanded opportunities for success, and clarity of focus.

2.2 Core Philosophy and Components

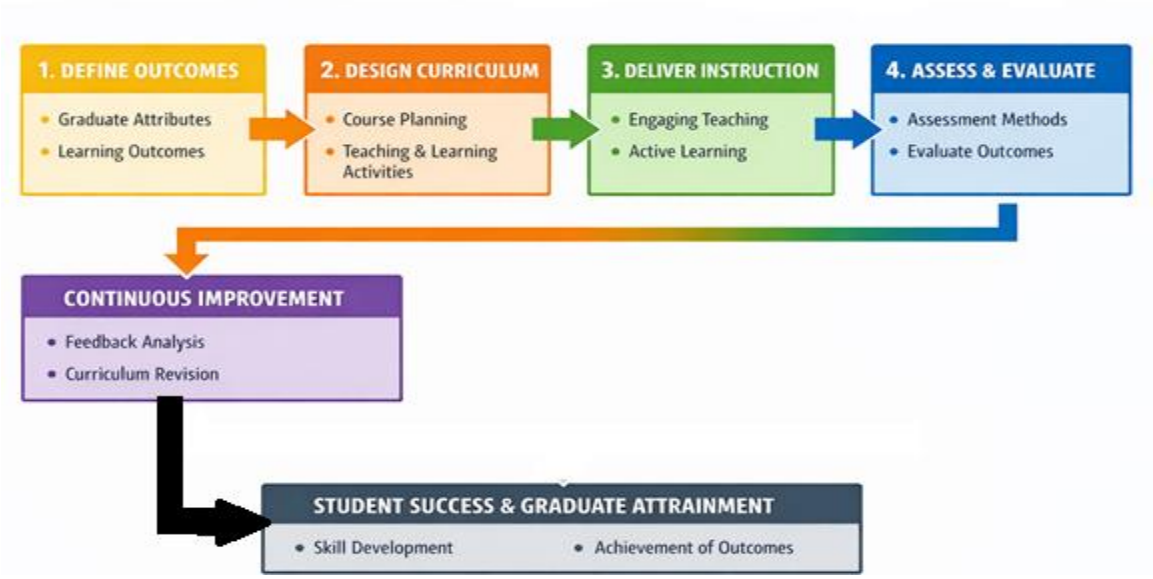
- **Student-Centric Learning:** Shifts focus from teaching (input) to learning (outcome), placing the student at the center of the educational process.
- **Outcome Focus:** Defines precise, measurable skills (course/program outcomes) learners should possess upon graduation.
- **Backward Design:** Curriculum is planned by first identifying desired results (career skills) and then mapping assessment and instruction to achieve them.
- **Competency Development:** Focuses on applying knowledge to real-world problems and developing professional skills.

2.3Principles of OBE

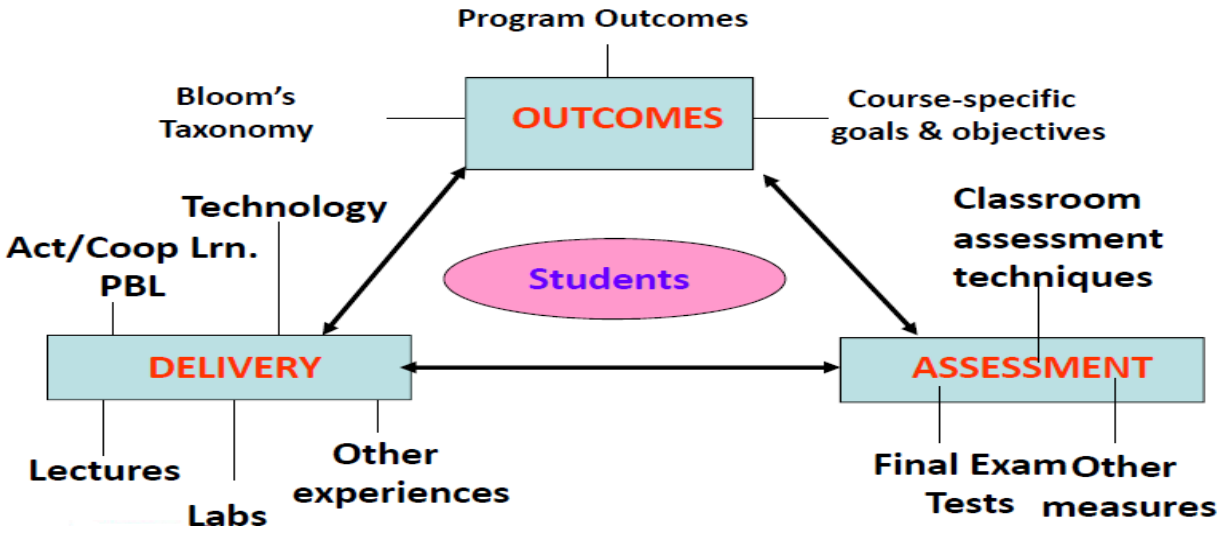
- **Clarity of Focus:** All teaching-learning activities focus on achieving the defined outcomes.
- **Expanded Opportunities:** Provides multiple pathways and opportunities for students to learn, acknowledging that everyone can reach high standards.
- **High Expectations:** Promotes high standards for all students, encouraging them to excel.
- **Key Design Downwards:** Aligning curriculum with desired outcomes.

  Real-World Application: Preparing graduates with skills required for employment, including professional skills and social responsibility.
- **Continuous Improvement:** Using assessment data to improve teaching methodologies and curricula continuously.
- **Transparency:** Clearly defining learning goals for students, teachers, and stakeholders.
- **Lifelong Learning:** Fostering the ability to continue learning throughout their careers.

OBE Implementation



OBE – Constructive Alignment



2.4 Implementation of OBE

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

2.5 Components OBE Frame work

1. **Vision and Mission Statements** - vision statement is what the Institute wants to acquire and mission is what an Institute is all about.
2. **Program Educational Objectives (PEOs):** Broad statements of what graduates are expected to achieve in their careers a few years after graduation.
3. **Program Outcomes (POs):** Statements that describe what students should know and be able to do by the time of graduation.
4. **Course Outcomes (COs):** Specific learning objectives for each course

2.6 Vision Mission Statements

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2.7 PEOs, PO and PSOs of the Department

Program Educational Objectives

PEO NO	PEO Statement
PEO1	Electrical Engineering Graduate will demonstrate knowledge base of Electrical Engineering to excel in industry and higher studies.
PEO2	Electrical Engineering Graduate exhibit competency in analytical abilities and problem solving capabilities on the basis of strong fundamentals in Electrical Engineering.
PEO3	Electrical Engineering Graduate will develop sustainable solutions for society with ethics and professionalism.
PEO4	Electrical Engineering Graduate will show professional qualities such as team work, leadership, and entrepreneurial thinking and communication skills.
PEO5	Electrical Engineering Graduate will be habitual to lifelong learning abilities.

12 Program Outcomes are already defined by NBA are taken as it is

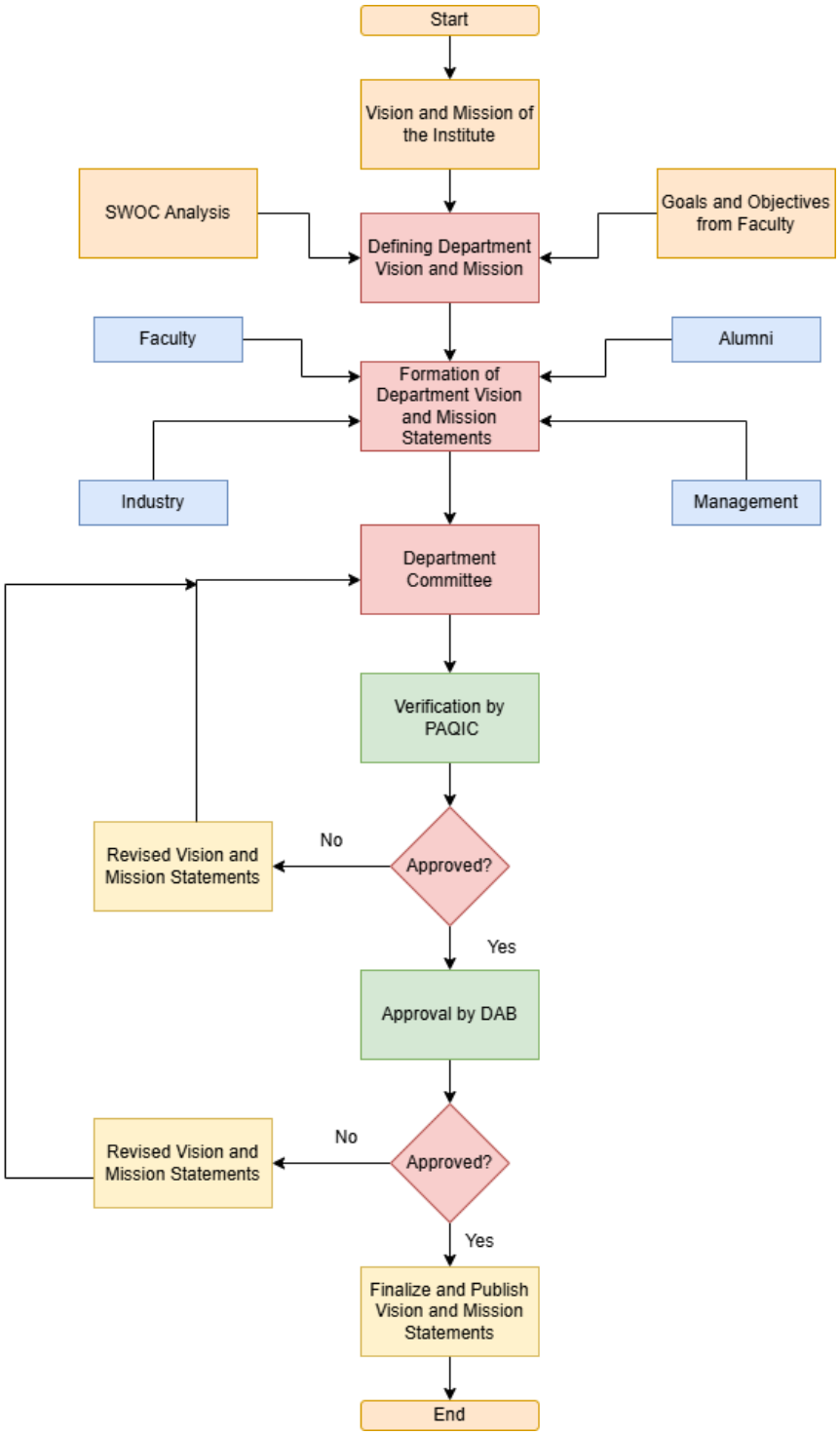
Program Specific Outcomes

PSO1	An ability to acquire adequate proficiency in the area of Energy Systems and Sustainability.
PSO2	An ability to acquire multidisciplinary skills in the area of Control and Drives.
PSO3	An ability to acquire enhanced skills and core competency in the field of Electrical Engineering through hands on training.

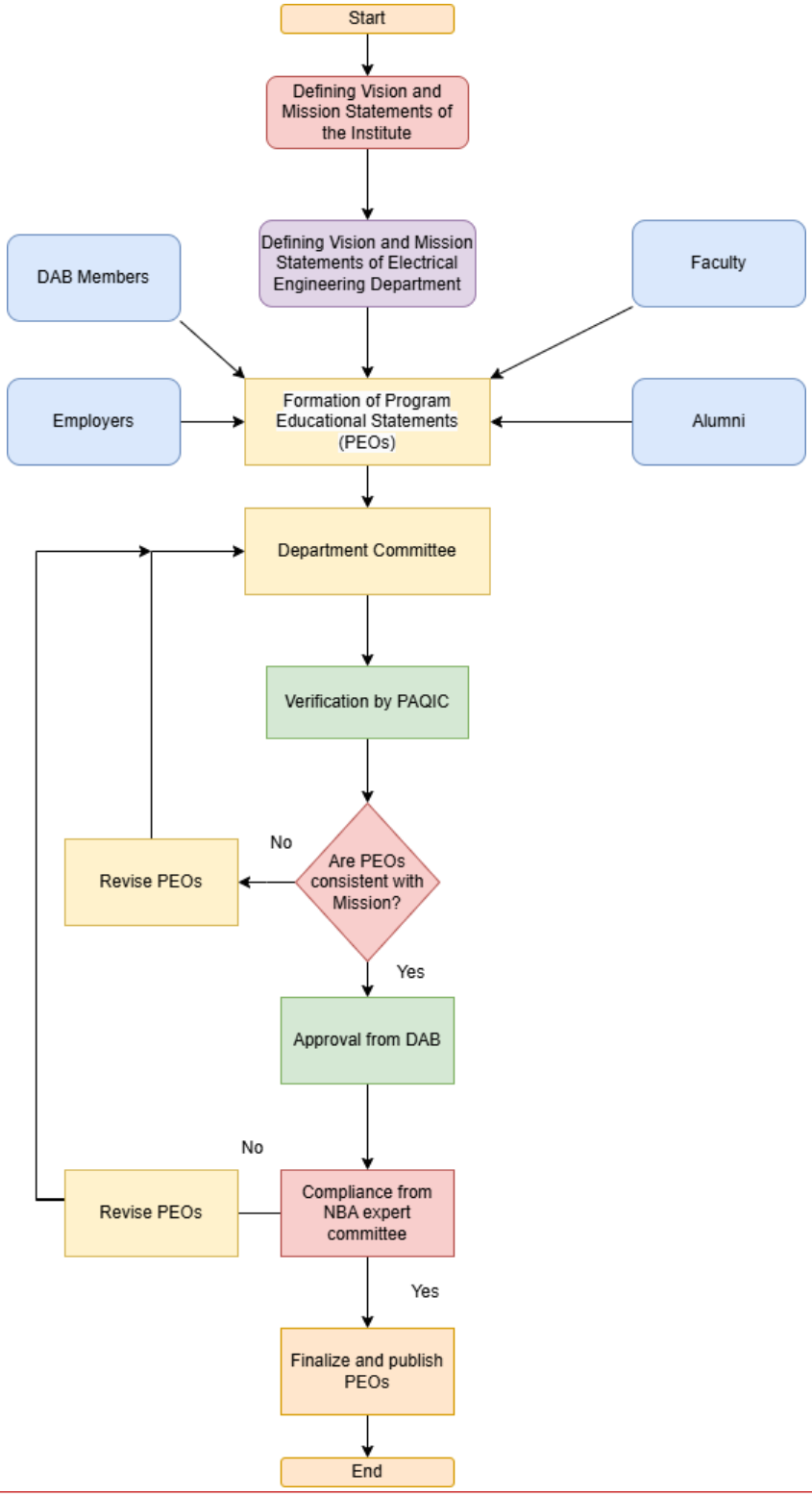
Department of Electrical Engineering
PROGRAM OUTCOMES (POs)

PO1:	**Engineering Knowledge:** An ability to apply knowledge of mathematics, science and Engineering fundamentals to analyze complex engineering problems.
PO2	**Problem Analysis:** An ability to identify, formulate and analyze complex engineering problems by reviewing research literature to arrive at substantiated conclusions.
PO3:	**Design/Development of Solutions:** An ability to design solutions for complex engineering problems, system components or processes to meet the specified needs of the society, considering safety and environment.
PO4	**Conduct Investigations of Complex problems:** An ability to carry out experiments, simulations and apply research methodologies to investigate the data for providing valid conclusions.
PO5	**Modern tool usage: An** ability to select and apply appropriate techniques, resources and modern engineering tools such as advanced controllers and application software for engineering activities.
PO6	**The Engineer and society:** An ability to assess and develop professional engineering practices catering the need of society considering safety, health, regulatory and other relevant issues.
PO7	**Environment and sustainability:** An ability to apply professional engineering knowledge to understand the impact on society and environment demonstrating the need for the sustainable development
PO8	**Ethics:** An ability to adopt professional ethics while committing professional and social responsibilities
PO9	**Individual and Team work:** An ability to develop multidisciplinary skills as an individual and as a member or leader in diverse teams.
PO10	**Communication:** An ability to communicate effectively with engineering community and society at large with effective documentation and presentation on engineering activities
PO11	**Project management and Finance:** An ability to demonstrate knowledge of Engineering and Management principles as a member or a leader to manage project and multidisciplinary tasks.
PO12	**Life-long Learning:** An ability to understand need and develop the habit of being lifelong learner to adopt to technological changes.

2.8 Process of Defining Vision and Mission of the Department



2.9 Process of Defining PEOs



2.10 Correlation with PEOs and Mission

PEOs	**Mission-I** Quality Education **M1**	**Mission-II** State of art **M2**	**Mission-III** Creation of platform for training R & D **M3**	**Mission-IV** Producing Sound Electrical Engineers **M4**
PEO1: Electrical Engineering Graduate will demonstrate knowledge base of Electrical Engineering to excel in industry and higher studies.	**3**	**2**	**2**	**3**
PEO2: Electrical Engineering Graduate exhibit competency in analytical abilities and problem solving capabilities on the basis of strong fundamentals in Electrical Engineering.	**3**	**3**	**3**	**3**
PEO3: Electrical Engineering Graduate will develop sustainable solutions for society with ethics and professionalism.	**1**	**2**	**2**	**3**
PEO4: Electrical Engineering Graduate will show professional qualities such as team work, leadership, and entrepreneurial thinking and communication skills.	**2**	**3**	**3**	**3**
PEO5: Electrical Engineering Graduate will be habitual to lifelong learning abilities.	**2**	**2**	**3**	**1**

2.11 Justification of PEO – Mission mapping

Co-relation and justification of PEOs and Mission are as follows:-

PEOs	**Mission**	**Co-relation**	**Justification**
PEO1: Electrical Engineering Graduate will demonstrate knowledge base of Electrical Engineering to excel in industry and higher studies.	**M1** Providing Quality education in the field of Electrical Engineering	3 (High)	J: Imparting quality education will strongly lead to achieving PEO1. R: Reason for strong support is imparting quality education with strong knowledge base for the employment and for higher studies.
	M2 Developing State of the art facilities in the department.	2 (Medium)	J: PEO1 is moderately consistent with M2 as development of the strong knowledge base through academic environment using modern tools is achieved. R: Reason for moderate support is continuous development in the infra-structure and up gradation of the laboratories with the latest facilities to update students with latest technologies.

	M3 Creation of platform for training R & D	2 (Medium)	J: PEO1 is consistent with M3 as development of strong knowledge base through imparting training and facilitating for Sponsored/funded /research projects. R: Reason – Management has given support and motivation for submission of project/research proposals. The state of the art laboratories are being developed such as Product Innovation Laboratory, Electric Vehicle laboratory, Robotics and Automation labs for student engagement in training, R & D activities.
	M4 Producing Sound Electrical Engineers	3 (High)	J: PEO1 is highly consistent with M4 as development of strong knowledge base led to producing sound engineers who are capable of serving the industry. R: Reason for moderate support is strong knowledge base prepare the students for various jobs in industry and also to become entrepreneur.
PEO2: Electrical Engineering Graduate exhibit competency in analytical abilities and problem solving capabilities on the basis of strong fundamentals in Electrical Engineering.	**M1**Providing Quality education in the field of Electrical Engineering	3(High)	J: PEO2 is strongly consistent with M1 as competency o the students is enhanced through imparting quality education. R: Quality education help students enhance analytica abilities and problem solving abilities due to provision o strong foundation to the students for basic sciences an basics of Electrical Engineering.
	M2 Developing State of the art facilities in the department.	3(High)	J: PEO2 is strongly consistent with M2 as problem solvin techniques can be improved through the laboratories wit the latest facilities. R: The state of the art facilities will help students to ge exposure to latest trends in industries and researc avenues. The students will be industry ready wit capabilities for solving and analyzing practical problem through state of the art laboratories.
	M3 Creation of platform for training R & D	3(High)	J: PEO2 is strongly consistent with M3 as competency o the students can be enhanced through training and researc activities. R: Encouragement to the students for completin internships, training programs, involvement in projects i the related field.
	M4 Producing Sound Electrical Engineers	3 (High)	J: PEO2 is highly consistent with M4 as providin fundamental knowledge to the students produces soun engineers who meet the challenges in industry. R: Needs of industry and other stake holders are fulfilled b developing competencies in analysis, synthesis an problem solving.
PEO3: Electrical Engineering Graduate will develop sustainable solutions for society with ethics and professionalism.	**M1** Providing Quality education in the field of Electrical Engineering	1(Low)	J: PEO3 is slight consistent with M1. R: Weakly consistent as quality education indirectly provides engineering solution on a global scenario.

	M2 Developing State of the art facilities in the department.	2 (Medium)	J: PEO3 is moderately consistent with M2 as technology i ever changing in the industry. R: Moderately consistent as facilities created needs to b improved on broader scale considering global scenario o technological advances.
	M3 Creation of platform for training R & D	2 (Medium)	J: PEO3 is moderately consistent with M3. R: Provision of training, creating hardware and softwar platforms for imparting training, involvement of student in R & D projects and exposure to R & D facilities wil lead to creating responsive engineers.
	M4 Producing Sound Electrical Engineers	3(High)	J: PEO3 is highly consistent with M4. R: Highly consistent as training the students with goo scientific and engineering breadth results in producin sound engineers.
PEO4: Electrical Engineering Graduate will show professional qualities such as team work, leadership, and entrepreneurial thinking and communication skills.	**M1** Providing Quality education in the field of Electrical Engineering	2 (Medium)	J.PEO4 is moderately consistent with M1 R: Quality education results in creating right minde students with imbibed professional qualities and will b able to work in diverse environment and in differen capacities.
	M2 Developing State of the art facilities in the department.	3(High)	J: PEO4 is highly consistent with M2 as professiona qualities of the students can be enhanced through the lates facilities. R: Highly consistent as these skills can be enhanced through the curricular, extra-curricular activities conducted using modern tools.
	M3 Creation of platform for training R & D	3(High)	J: PEO4 is highly consistent with M3 as professional skill of the students enhances giving exposure through training, R & D activities. R: Highly consistent as these skills are for professional accomplishments. The qualities can be improved by acquiring training and involvement in research and development.
	M4 Producing Sound Electrical Engineers	3(High)	J: PEO4 is highly consistent with M4 as sound engineers are produced inculcating professional skills in them. R: Highly consistent as overall developed students lead to sound engineers and professional who are serving the industry.
PEO5: Electrical Engineering Graduate will be habitual to lifelong learning abilities.	**M1** Providing Quality education in the field of Electrical Engineering	2 (Medium)	J: PEO5 is moderately with M1 as imparting quality education motivates the students for lifelong learning. R: Quality education creates methodical students having urge of deep understanding of facts and figures leading to lifelong learners for achieving great success.

	M2 Developing State of the art facilities in the department.	2 (Medium)	J: PEO5 is moderately consistent with M2. R: Sate of the art laboratories facilities and hands on ignites lifelong learning habits.
	M3 Creation of platform for training R & D	3(High)	J: PEO5 is highly consistent with M3 as training and research activities motivate the students for lifelong learning. R: Strongly consistent as abilities of the students for lifelong learning are supportive for research and development activities.
	M4 Producing Sound Electrical Engineers	1(Low)	J: PEO5 is slightly consistent with M4. R: An ability of life-long learning produces sound electrical engineers.

3.0 Course Outcomes

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

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

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

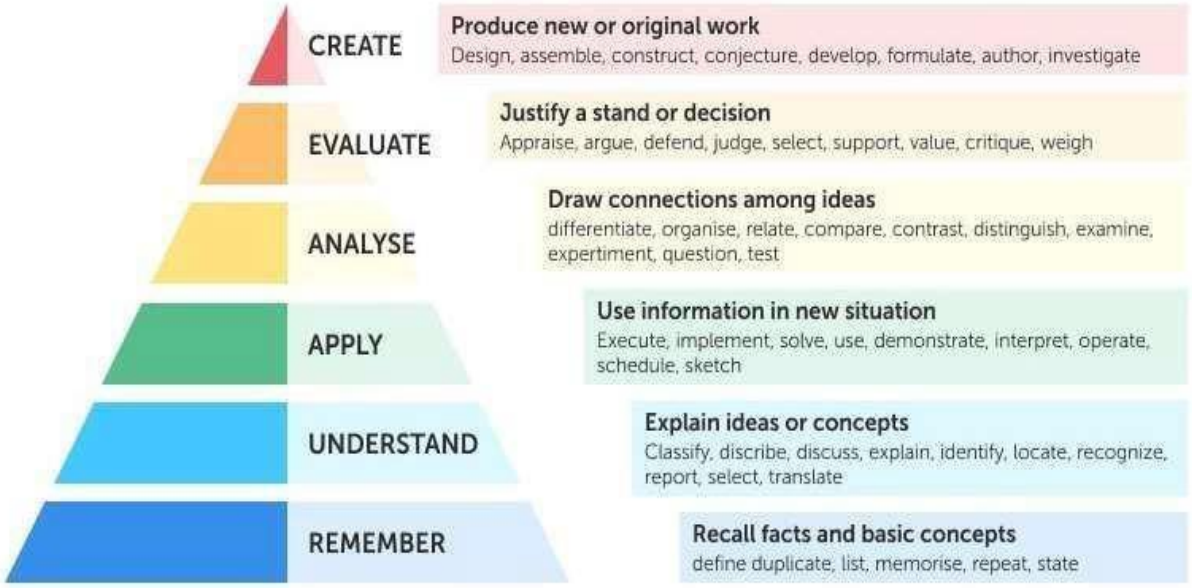
Examples of good action words to include in course outcome statements:

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

3.1 Bloom's Taxonomy

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

Bloom's Level in graphics form



3.2 Good Learning Outcomes : SMART *enough*

1. Specific – *to one learning behaviour (Clarity)*
2. Measurable - *includes the criteria for success (attainable)*
3. Actionable - *can be demonstrated with evidence, or*

   Observed (intended output and specific)
4. Relevant – *to future experiences or work place*
5. Timed – *to be achieved within certain time constraints*

3.3 Action verbs for Bloom's level

3.4 CO Definition

Department has under gone NBA under OBA regime from 2019 to 2022 and hence documentation based on OBE was initiated from form 2014. The process of defining COs was started in the department in 2014. 2012 Pattern was under implementation where university curriculum did not mentioned CO. Hence department had set up the process of formation of CO in 2014 and same has been reiterated for subsequent years even for new cycle of NBA from 2025 onwards. 2015 pattern and 2019 pattern curriculums set by university had included course objectives and course outcomes. These Course Outcome Statements given in curriculum by SPPU are reviewed and if desired these are revised or changed in totality based on contents of the course and hence at the department level department had drafted process which is as follows –

1. Orientation workshop for faculty at institute level for CO formation.
2. Formation of Subject Core Groups and Group Coordinator.
3. Brain storming sessions for framing CO statements in department level and in course group meetings.
4. Formation of CO statements by individual faculty for respective subjects.
5. Review of CO statements in respective Subject Core Group meetings. If required modification were suggested in CO statements and modified COs got approved in Course group meetings.
6. Final approval for CO statements is given by Department Quality Assurance Committee PAQIC.
7. Approved CO statements are then disseminated at various levels, discussed with students during course conduction.

The Course Outcome Statements given in curriculum by SPPU are reviewed. If desired the new COs are proposed for implementation of 2019 pattern. The above mentioned steps were followed for formation of CO statements. The finalized COs are then approved by PAQIC.

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

- The CO statements are defined by considering the course content
- The statements are aligned to the learning that results from the course
- The statements are student centric
- For every course there are 6 Course Outcomes having action

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

3.5 Course Outcomes

C201 Course Name: Engineering Mathematics III

At the end of Course student will be able to

CO	Course Outcome Statement	Blooms Level
C201.1	**Solve** higher order linear differential equation using appropriate techniques to model and analyze electrical circuits.	Apply (3)
C201.2	**Apply** Integral transforms Laplace transform for problems related to control systems frequency domain analysis.	Apply (3)
C201.3	Fourier transform and Z-Transform to **solve** problems related to signal processing and control systems.	Apply (3)
C201.4	**Apply** Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to energy management, power systems, testing and quality control.	Apply (3)
C201.5	**Perform** Vector differentiation and integration, analyze the vector fields and apply to wave theory and electro-magnetic fields.	Apply (3)/Analyze(4)
C201.6	**Analyze** Complex functions, conformal mappings, and perform contour integration in the study of electrostatics, signal and image processing.	Analyze(4)

3.6 Attainment of Course Outcomes

After defining CO next phase is to establish the process of Course Outcome attainment. The discussions were carried out in departmental and OBE meeting for CO, PO and PSO attainment. The course group meeting also helped in deciding subject difficulty levels, target attainment levels for all subjects.

The department has established a well-defined CO attainment process after gradual reforms. The process is based on the guidelines given in NBA documentation. Department has developed MS-Excel based template for CO attainment. For calculation of attainment various inputs are required such as

1. Formation of course groups for taking decisions for subject difficulty level, setting targets etc.
2. Assessment tools used for attainment – Internal and External tools
3. Average marks for setting target marks
4. Decision of weight function for target marks based on subject difficulty level
5. Mapping of COs with internal and external assessment tools.

The first step in establishment of OBE in the department started with formation of cohesive subject groups. Based on broad area and requirements all the courses from second year to final year are grouped in specific domain as given in the list is given in table.

Details of Course Groups

Course Group	Name of group members	Group Coordinator
Group-I:- Power Systems-I		**Dr. M. S. Thakare**
Power Generation Technology	Prof. S. H. Yamalla	
Power Systems I	Prof. O.S. Pawaskar	
Power Systems II	Prof O.S. Pawaskar	
Power System Operation & Control	Dr. M. S. Thakare	
Switchgear & Protections	Prof. U. B. Sarode	
Group-II:- Power Systems-II		**Prof. O. S. Pawaskar**
Power Quality	Prof. O.S. Pawaskar	
Alternate Energy Systems	Dr. M. S. Thakare	
Electrical Installation Design and Condition based Maintenance	Prof .Dr. M. P. Bhawalkar	
Energy Audit and Management	Prof. Dr. M. P. Bhawalkar	
Smart Grid	Prof. Dr. S. T. Gaikwad	
Solar PV Systems	Prof. S. H. Yamalla	
Solar thermal Systems	Dr. M. S. Thakare	
Energy Storage Systems	Prof. Mrs. G. M. Karve	
Group-III:- Machines & Control		**Prof. U. B. Sarode**
Electrical Machines I	Prof. Mrs. P. R. Khatri	
Electrical Machines II	Prof. U. B. Sarode	
Computer aided Design of Electrical Machines	Prof. Mrs. G.M. Karve	
Control System Engineering	Prof. Mrs. P. R. Khatri	
Advanced Control Systems	Prof. Mrs. R. A. Ranjekar	
Digital Signal Processing	Dr. U. S. Thakar	
Electrical and Electronics Engineering	Prof. P. G. Jamdade	
Electrical Machines and Utilization	Prof. P. G. Jamdade	
Group-IV:- Electronics		**Prof. Mrs. R. A. Ranjekar**
Analog and Digital Electronics	Prof. Mrs. P. R. Khatri	
Advanced Electric Drives & Control	Prof. Dr. M. P. Bhawalkar	
Fundamentals of Microcontroller and its Applns	Prof Mrs. R. A. Ranjekar	
Advance Microcontroller and Embedded Systems	Prof. Mrs. R. A. Ranjekar	
IOT & Its Applications in Electrical Engg	Prof. Mrs. R. A. Ranjekar	
Programmable Logic Controller	Prof. Dr. Mrs. U. S Thakar	
Group-V:- Allied-I		**Prof. G.M. Karve**
Illumination Engineering	Prof. P. G. Jamdade	
Material Science	Prof. Mrs. G. M. Karve	
Electrical Measurements and Instrumentation	Prof O.S. Pawaskar	
Network Analysis	Dr. Mrs. U.S. Thakar	

Numerical methods and Computer Programming	Prof. Dr. M. S. Thakare	
Industrial and Technology Management	Dr. S. T. Gaikwad	
Electric Mobility	Prof. S. H. Yamalla	
Electric & Hybrid Vehicles	Dr. S. T. Gaikwad	
Group-VI:- Allied-II		
Seminar	Prof. Mrs. P. R. Khatri	
Soft skill		
Project Based Learning	Prof. Mrs. G. M. Karve	
Internship	Dr. S. T. Gaikwad	**Prof. Mrs. U. S. Thakar**
Project	Dr. Mrs. U. S. Thakar	
Project Management	Dr. S. T. Gaikwad	
Engineering Economics I	Dr. M. S. Thakare	
Engineering Economics II	Dr. M. S. Thakare	
Engineering Mathematics III	Prof. D. R. Irole	

In course group meetings it was decided to make unitize COs and number to be six for uniformity (with exceptions for audit and other special courses). Individual faculty and collectively core group members decided the number of COs and finalize the CO statements. It is decided to use measurable action verbs according to Bloom's Taxonomy level while framing CO statements. Students are orientated with outcome based education, CO, PO and PSO.

1. **Selection of Assessment Tool and Its mapping with CO –**

   - Assessment tools are categorized as **External and Internal Tools**.
   - External tools consists all university examinations
   - Internal Tools consists of Mid-term Tests/Assignments/MCQs/ Short Tests/Tutorials etc.
   - All applicable assessment tools are mapped with respective COs.

The decision of assessment tools through university examination is based on the structure of the course. The applicable heads like online, insem, TW, PR/OR etc. are used for assessment. These tools are mapped with respective Cos. The internal assessment tools are chosen by individual faculty such that all the COs are mapped through the selected assessment tools.

A. Selection of assessment tools for CO attainment

The direct attainment level of CO is based on University level evaluation and internal level evaluation.

a) University level evaluation – under this all exam heads as given in the respective curriculum structures are considered. The details of which are given in following tables from first year to final year levels.

Examination scheme for First Year

Examination	Evaluation Scheme /Marks	Based on Syllabus	Direct Co attainment	Direct PO/PSO attainment
In semester examination	30	Unit 1 & 2	CO1 and CO2 from respective subject	All relevant POs /PSOs which are mapped through COs
End Semester examination	70	Units 3 to 6	CO3 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs
Term work Examination	25/50	Unit 1 to 6 for subjects	CO1 to CO6 from respective subjects	All relevant POs /PSOs which are mapped through COs
Tutorials	25/50	Unit 1 to 6 for subjects	CO1 to CO6 from respective subjects	All relevant POs /PSOs which are mapped through COs

Examination scheme for Second Year, Third Year and Final Year (2019)

End semester examination				
Examination	Evaluation Scheme /Marks	Based on Syllabus	Direct Co attainment	Direct PO/PSO attainment
In Semester Examination	30	Unit 1 & 2	CO1 and CO2 from respective subject	All relevant POs /PSOs which are mapped through COs
Tutorials/ Term Work examination	25/50	Unit 1 to 6	CO1 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs
Oral / Practical Examination	25/50	Unit 1 to 6	CO1 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs
End semester examination	70	Unit 1 to 6	CO1 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs

Examination scheme for Final Year (2015)

End semester examination				
Examination	Evaluation Scheme /Marks	Based on Syllabus	Direct Co attainment	Direct PO/PSO attainment
In Semester Examination	30	Unit 1 & 3	CO1, CO2 and CO3 from respective subject	All relevant POs /PSOs which are mapped through COs
Tutorials/ Term Work examination	25/50	Unit 1 to 6	CO1 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs
Oral / Practical Examination	25/50	Unit 1 to 6	CO1 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs
End semester examination	70	Unit 4 to 6	CO4 to CO6 from respective subject	All relevant POs /PSOs which are mapped through COs

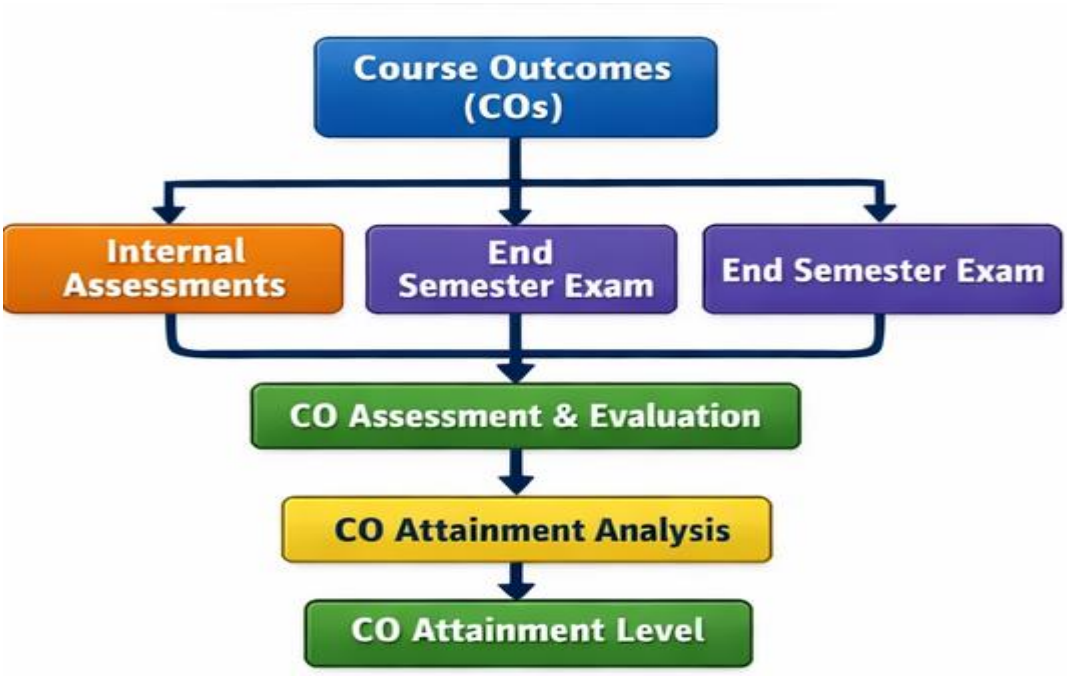
b) Internal Assessment tools

Internal Assessment tool

Internal Evaluation	**Marks**	**Based on Syllabus**	**CO attainment**	**PO/PSO attainment**
Mandatory				
Midterm test	20/30	Unit 1 and 2	CO1, CO2	All relevant POs /PSOs which are mapped through Cos
Continuous Evaluation (for Term work)	10 per experiment/ assignment	Laboratory Course, Entire Syllabus + Content beyond	All COs	All relevant POs /PSOs which are mapped through Cos
Optional /Flexible				
Class test	Flexible/ Optional	Units specified by Faculty	COs relevant to units specified	All relevant POs /PSOs which are mapped through Cos

Assignments	Flexible	Units specified by Faculty (Preferably 2 to 3)	COs relevant to units specified	All relevant POs /PSOs which are mapped through Cos
Laboratory Assignments	Flexible/ Optional	Units/topic/ experiment specified by Faculty (Preferably 1 to 2)	COs relevant to units specified	All relevant POs /PSOs which are mapped through Cos
1Quiz/Poles 2 Student Presentations 3 Short tests	Optional	Units/topic/ experiment specified by Faculty	COs relevant to units specified	All relevant POs /PSOs which are mapped through Cos

CO Attainment Process



For setting the target CO attainment level for the first time for a course, the difficulty level of the course is taken into account. Accordingly, all courses in the curriculum are divided into 3 categories mainly High difficulty level, Medium difficulty level and Low difficulty level considering the contents of the course.

For the Academic Year 2020-21 the starting target levels are set as -
High difficulty level courses – 1.6
Medium difficulty level courses – 1.7
Low difficulty level courses – 1.8

Department has developed MS Excel Utility for calculation of attainment of CO

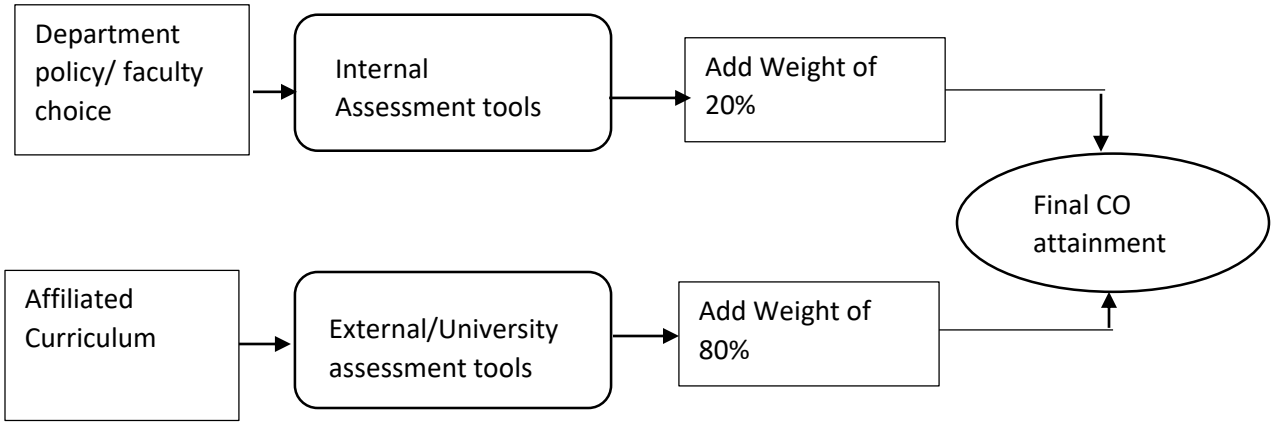
After declaration of results of semester database is prepared which include details of students such as name, exam number. The marks obtained by individual students in external and internal tools applicable for that course and then template calculate CO attainment as per the guide lines given in NBA documentation. It takes into account direct attainment only with following weights

80% weightage is given for external heads i.e. University examination score and 20% to internal examination score.
The rule for calculation of CO attainment is

a. Mapping of assessment tools with individual Cos
b. Calculation of number of students securing marks greater than target (bench mark) marks for each tools
c. Calculation of attainment level is based on –

Criterion	Attainment level
60% or more students scored marks >= set target marks (STM)	1
70% or more students scored marks >= set target marks	2
80% or more students scored marks >= set target marks	3

Final CO Attainment Process



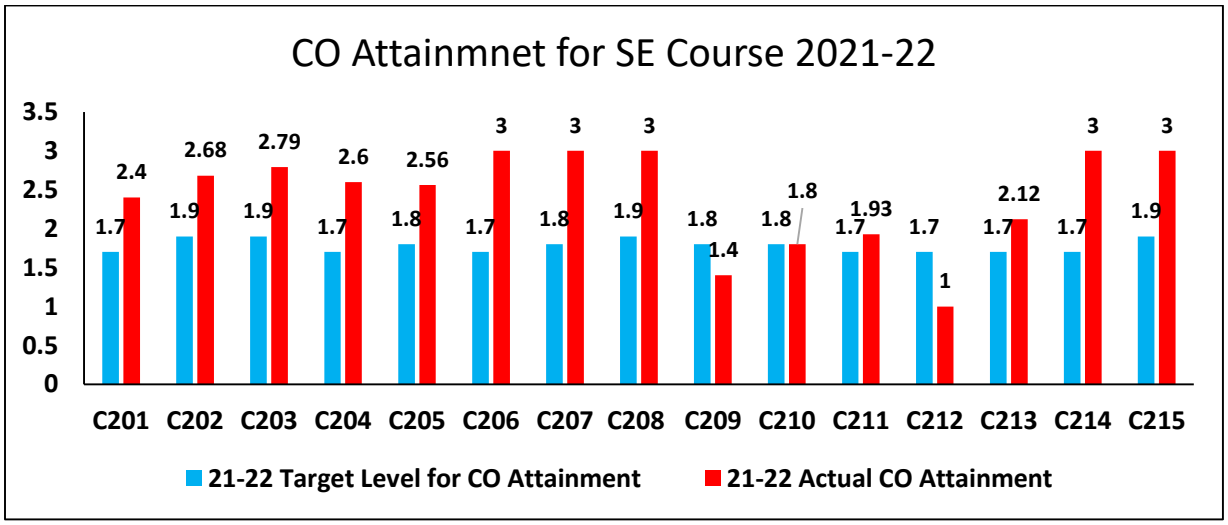
The outcome levels of COs from internal and university examinations are considered on the scale of 0 - 3 as shown below

Level of Attainment	Rule for Attainment
3	80% or more students having more than benchmark marks
2	70% or more students having more than benchmark marks
1	60% or more students having more than benchmark marks
0	less than 60% students having benchmark marks

On the basis of process defined Course Outcome attainments are calculated for all courses for UG program in Electrical Engineering. The attainment levels for three years (2021-24) are tabulated below where target attainment levels and actual attainment levels are shown. The blank spaces are due to non-opted elective subject in respective year. The details of template with attainment is shown below.

Comparing final CO attainment value with set target CO attainment level –

The final CO attainment level (FAL) for the course as a whole is compared with the set target attainment level (STAL).
If FAL > STAL, the STAL is increased for next academic year.
If FAL = STAL, the STAL is kept as it is for next academic year.
If FAL < STAL, the reasons for less attainment are identified with necessary corrective actions to be taken for next academic year. A sample CO attainment profile is shown below.

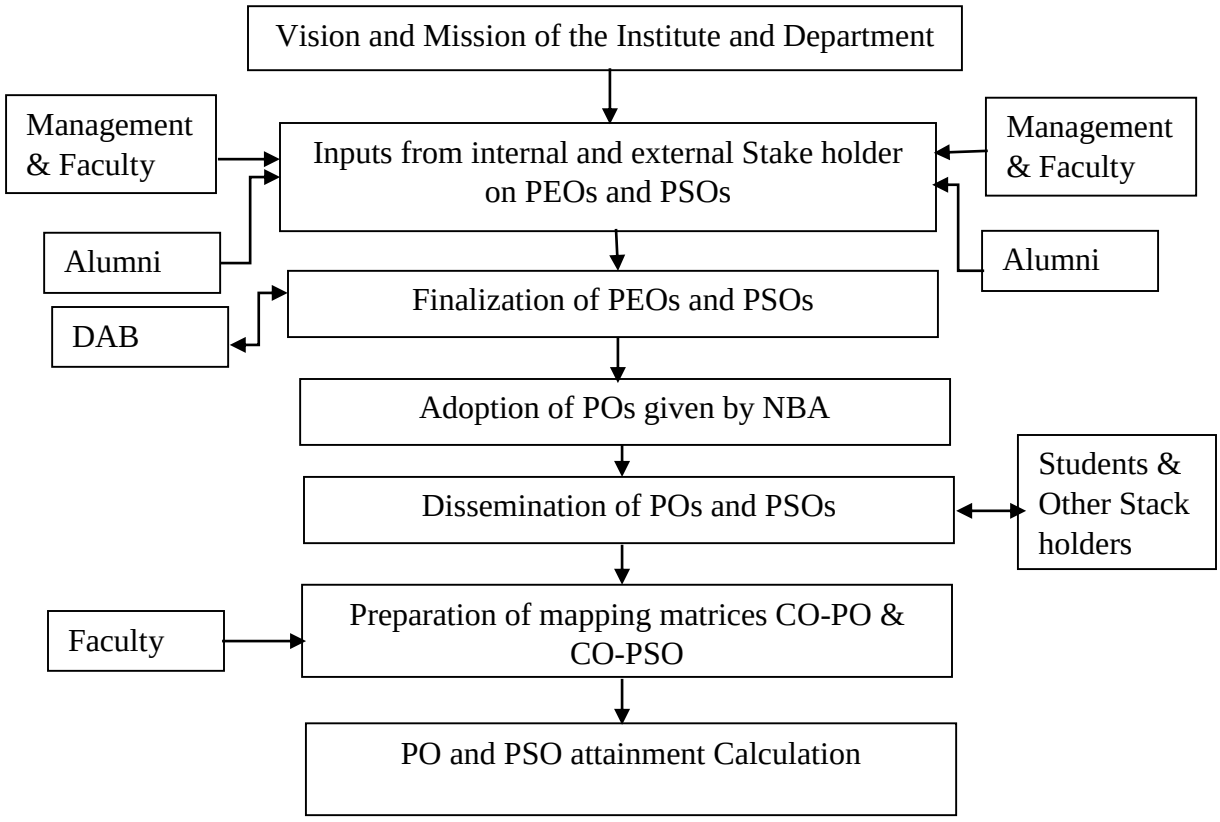


3.7Attainment of PO and PSOs

1. Program Outcomes based Graduate Attributes given by NBA are adopted by department. Therefore 12 Program Outcomes consisting of development in cognitive and psychomotor skill of engineering graduate. PO ensures demonstration of technical competency and behavioral aspects from graduating engineer.
2. The process for drafting PSO statements is initiated based on feedbacks collected from stake holders.
3. The PSO statements are drafted through brain storming in departmental meetings. It was decided that PSOs should reflect domain expertise based on department strengths.
4. Before drafting PSO statements consideration of linkages with Vision-Mission statements are checked.
5. Discussion on POs and PSOs in DAB meetings seeking feedback for modifications, if any.
6. Finalization of PSOs statements after incorporating suggestions given by DAB members.
7. Discussion on mapping levels of Course Outcomes and Course with Program Outcomes and Program Specific Outcomes at department level meetings, course level meetings.
8. Articulating Course – PO mapping Matrices and Course - PSO Mapping with Justification Every course teacher prepare Course Outcome – PO and Course Outcome PSO mapping. Finally Course –PO and Course –PSO mapping with justification is done by individual teacher.
9. Final mapping matrices are prepared for each year which will be used for PO and PSO attainment.

The final statements are checked for consistency and linking with PEOs and Vision and Mission statements.

The process of articulation of PO and PSO are indicated in following Flow chart.



Process of Formation of PEOs, POs and PSOs,

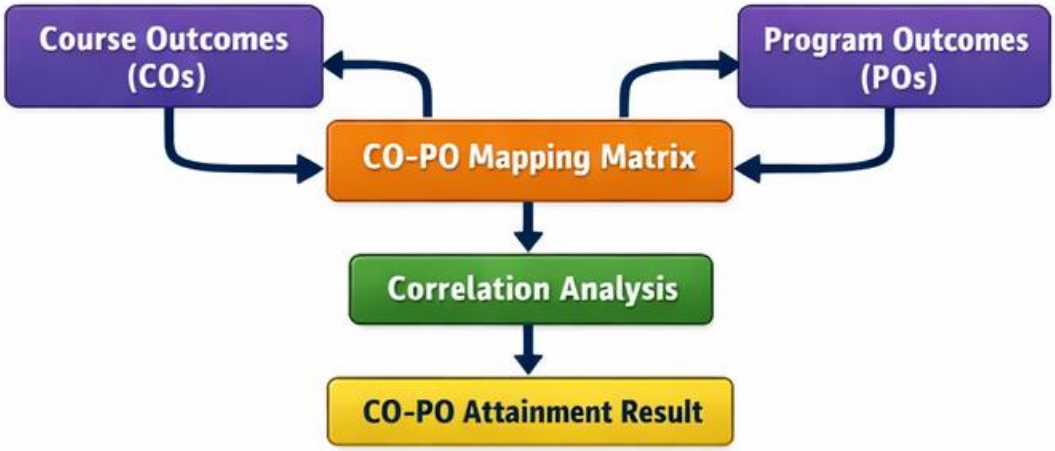
After articulation of PO and PSO statements and establishing correlation matrix process is established to obtain PO and PSO attainment. Then tools for assessment of PO and PSO are required to be defined. The discussion of is carried out as given below.

Process of PO and PSO attainment

The POs and PSO attainments are computed using direct and indirect tools. As per the guidelines given in NBA documentation, 80% weightage is given to direct assessment of POs and 20 % to indirect assessment. The process of attainment is described in flowchart given in Fig.2

The direct assessment is based on number of courses mapped with individual PO. Hence the calculation is based on weighted average. Indirect attainment is based on surveys and feedbacks obtained from various stake holders

3.8 CO – PO Mapping

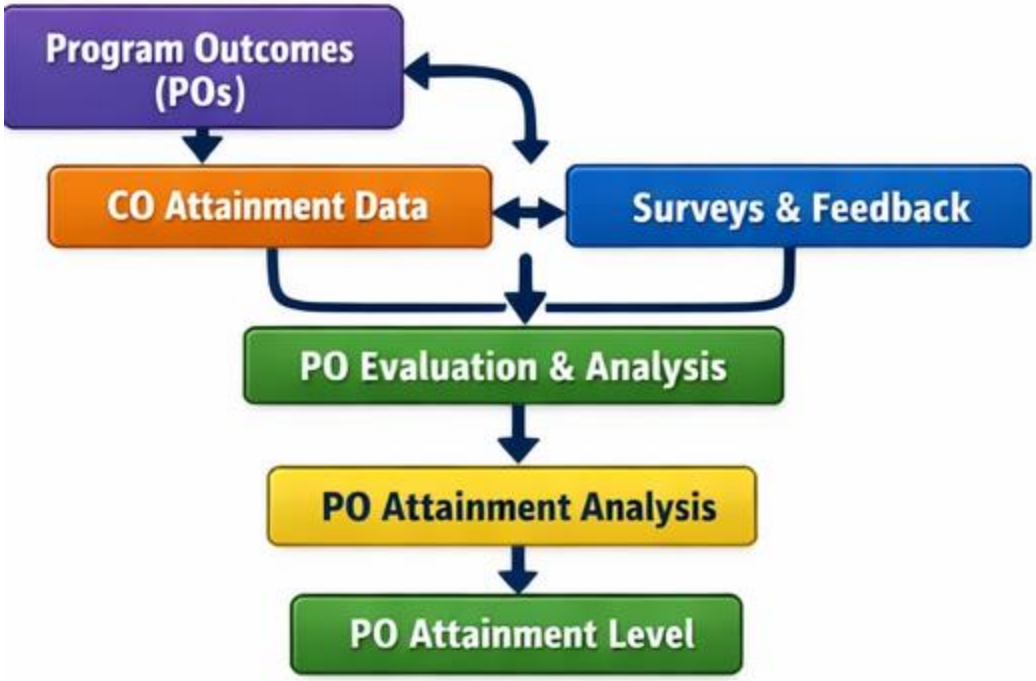


Process of CO – PO mapping

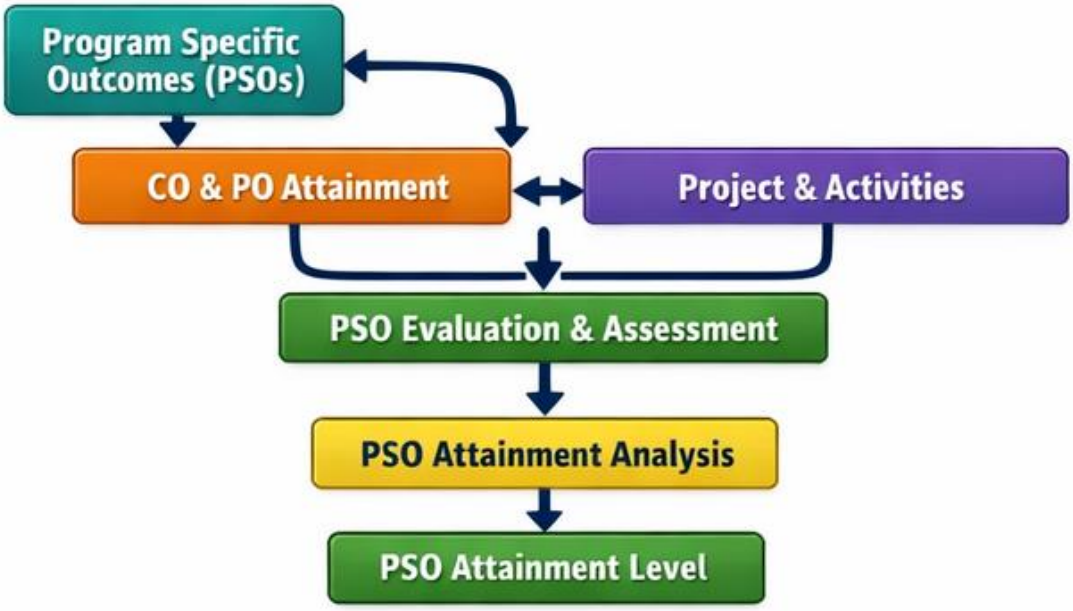
A sample CO-PO mapping is shown in table given below.

Table Course – Program Outcome Mapping table for 2021-2022

Course Code	Sub	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C101	Engg Maths I	3.00	3.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
C102	Engg Physics	3.00	1.17	1.00	1.40	0.00	0.00	1.00	0.00	0.00	0.00	0.00	2.00
C103	Systems in Mech Engg	2.83	1.67	1.75	1.00	2.00	1.00	1.40	0.00	0.00	1.00	0.00	1.00
C104	Basic Electrical Engg	3.00	2.83	2.33	2.33	0.00	2.00	1.50	0.00	0.00	0.00	0.00	2.67
C105	Prog & Prob Solving	1.50	1.50	1.25	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
C106	Workshop	1.50	1.00	1.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00
C107	Audiit Course I Environment Studies I	2.75	2.00	2.50	1.50	1.00	2.50	2.75	2.50	2.50	1.50	1.50	2.25
C108	Engg Maths II	2.80	2.60	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00

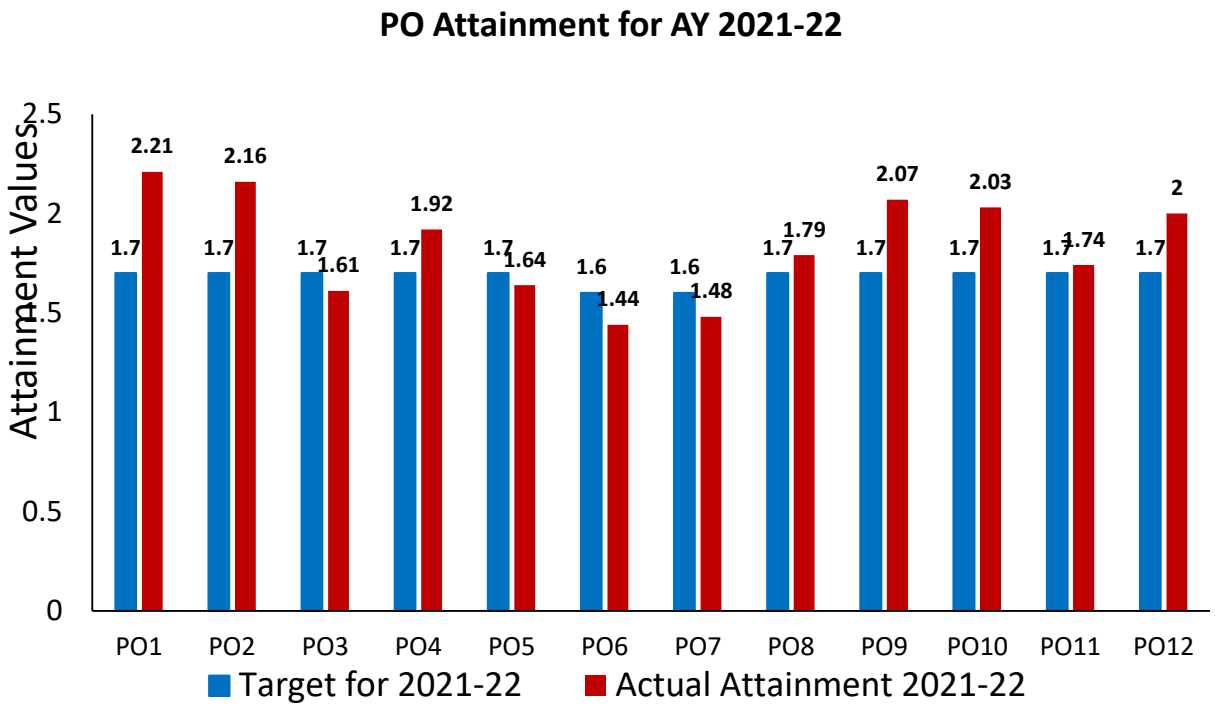


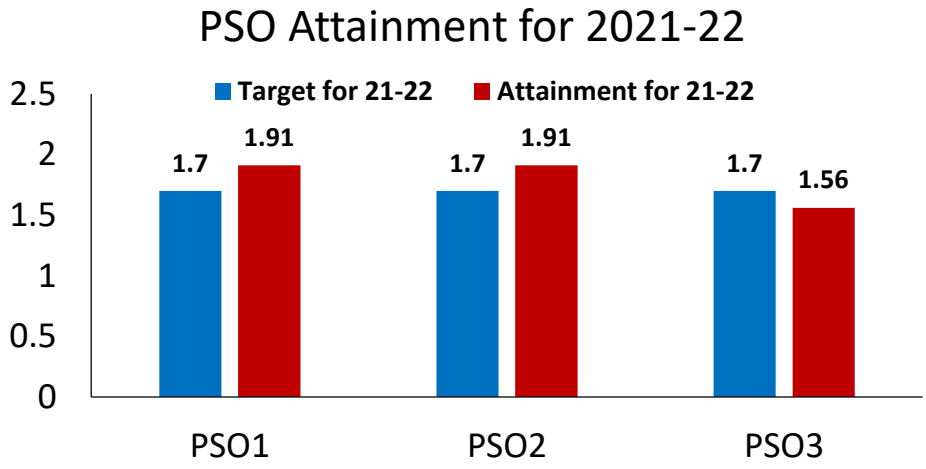
PO attainment simplified flowchart



PSO Attainment Simplified Process

Sample PO and PSO attainment graphs are presented below.





Close loop action is initiated based on attainment values and analysis thereafter.

4.0 Summary

- Implementation of Outcome based Education philosophy in Department of Electrical Engineering helped department students to excel in core industry with increased placement in core industries. OBE ensured students acquire requisite skill required for core industry and higher education. Hence student centric learning is taking place in the department.
- With adoption of OBE in the department conventional classroom teaching is on the verge of becoming obsolete. Teacher must be equipped and exercise new pedagogical initiatives for active learning which can be challenging for large group of students. Institute can support with appropriate resources.
- With effective OBE implementation results in win –win situations for all the stake holder.

5.0 Reference

1. NBA India. Outcome Based Accreditation – Manual for Tier-II Institutions. National Board of Accreditation. Retrieved from https://www.nbaind.org
2. NBA, Awareness Workshop on Outcome-based Education and Accreditation for the Engineering Colleges in Telangana jointly organised by National Board of Accreditation and JNTU, Hyderabad, Presentations, NBA Accreditation- Introduction, Assessment Methodology, Washington Accord by Dr. Anil Kumar Nassa, Member Secretary, NBA, New Delhi
3. NBA , Awareness Workshop on Outcome-based Education and Accreditation for the Engineering Colleges in Telangana jointly organised by National Board of Accreditation and JNTU, Hyderabad, Presentations, Methods of Assessment and Evaluation: Assessment Tools, Assessment of POs, PSOs, PEOs, & COs and thoughts on Closing the Loop for Continuous Improvement by: Prof. S.S. Pattnaik, Vice Chancellor, Odisha State Open University, Sambalpur, Odisha.