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TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

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An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

— AN AUTONOMOUS INSTITUTE —

TEAM

TGPCET'S ENGINEERING ASSESSMENT MANUAL: ROADMAP FOR OUTCOME BASED ASSESSMENT

B.Tech | B.Arch | M.Tech | MBA | MCA | Polytechnic | BAMS | D. Pharm | B. Pharm | B.Sc Nursing | Physiotherapy

TGPCETS's Engineering Assessment Manual (TEAM)

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PREFACE

This manual "TGPCET's Engineering Assessment Manual (TEAM)" is developed for the facilitators in outcome based education (OBE) for calculations of the attainment of the outcomes in the OBE paradigm. The manual outlines the principles, processes, and guidelines for implementing learner centred approach to get the targeted outcomes. It focuses on defining clear, measurable learning outcomes that the learners are expected to achieve by the end of a course, program, or educational experience.

The TEAM is structured to provide a step-by-step approach to understanding and implementing Assessment in Outcome-Based Education. It begins with the Vision and Mission of the Institute, explaining the process of framing Vision and Mission in department in sync with the Institute. From there, the manual delves into the practical aspects of framing the course outcomes and the course articulation matrix, crafting meaningful and measurable learning outcomes, and implementing effective assessment strategies to gauge student progress.

Throughout the manual, demonstrations, examples, are used in order to make the process simpler to the facilitators and easy to use as it is in the manual. Formats of the surveys are included as a ready reference for the indirect attainment and make the assessment more precise and relevant. Finally an attempt is made to enlighten the facilitators to understand the process of attainment of the outcomes in OBE. We hope that this manual will make a substantial difference to the facilitators and enable them to do the assessment of the learners with a greater ease.

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Prof. Chetan Jambhulkar
Prof. Pragati Patil
Dr. G.K. Awari

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Many of our professional colleagues including the Head of Departments, Deans, Directors of the institute have also made a variety of inputs – most of which were made orally at professional meetings. We would also like to acknowledge the help extended by Mr. Rohan Dhumne for extending help for the design part of the document. Finally we acknowledge everyone who have directly or indirectly provided their support in writing the manual.

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Chapter 1
Vision and Mission

Institute Vision and Mission

VISION

To emerge as a learning Center of Excellence in the National Ethos indomains of Science, Technology and Management

MISSION

M1 - To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.

M2 - To provide facilities and services to meet the challenges of Industry and Society.

M3 - To facilitate socially responsive research, innovation and entrepreneurship.

M4 -To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Department Vision and Mission

(Sample of Electrical Engineering Department)

VISION

To emerge as a learning hub and centre of excellence in the domain of Electrical Engineering

MISSION

- To disseminate knowledge replete with quality education in the field of Electrical Engineering in meticulous and methodical manner.
- To provide platform to address societal issues as well as challenges faced by industries.
- To develop research culture and inculcate innovative and entrepreneurial skills.
- To ensure overall development of students and staff by instilling knowledge and professional ethics as a part of lifelong learning.

Chapter – 2

Program Educational Objectives, Program Outcomes, Program Specific Outcomes

2.1 Process for Defining Vision and Mission of the Department

Following steps are followed to establish Vision and Mission of a department

Step 1. The Vision & Mission of the Institute is taken as the reference for initiating the process of framing of Vision and Mission of the department.

Step 2: The Department holds a series of interaction meetings with the stakeholders involved in the process, which include faculty, students, employers, alumni, and parents, in order to obtain the necessary inputs such as technical and generic skills required to sustain in the local as well as global market, as well as Industry Advances in Technology and R & D. A draft copy of the Department's Vision and Mission is created.

Step 3: The draft copy evaluated for consistency with the Institute Vision and Mission, presented to the Department Quality Assurance Cell (DQAC) for input and approvals and then is presented to the Internal Quality Assurance Cell (IQAC).

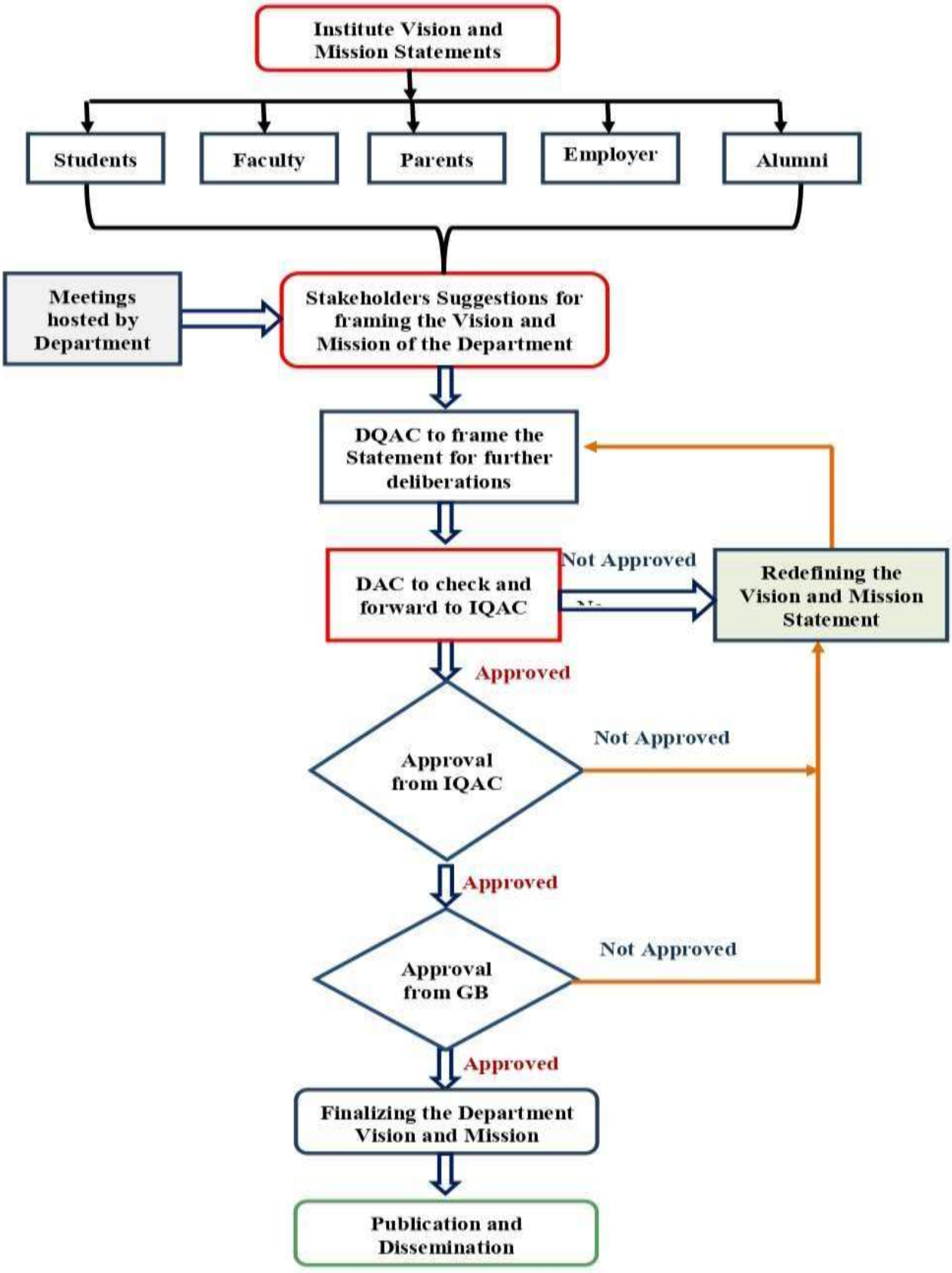
Step 4: IQAC of the institute peruses the Department Vision and Mission received from the DQAC of the Department and checks the consistency with the Institute Vision and Mission and if required gives a revision of the statement to the respective Department.

Step 5: The approved statements are then presented in the Department Advisory Committee (DAC) for further consent and approvals. DAC gives the consent to IQAC for further actions required for the final approval.

Step 6: IQAC presents the final copy of the statement to the Governing Body (GB) for the final approval and release of the Statement.

Step 7: The process may be repeated in case the GB rejects the statement presented by the IQAC or else in Step 6, GB gives the necessary approvals for the further dissemination of the statements to the stakeholders.

The process for defining department vision and mission are illustrated in the flow chart Figure 2.1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2.2 Program Educational Objectives (PEO's):

The Program Educational Objectives of an engineering degree program are the statements that describes what the graduates are expected to perform and achieve during the first few years after graduation. The PEOs may be guided by global and local needs, vision of the institution, long term goal, etc.

2.3 Program Outcomes (PO's):

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, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

2.4 Program Specific Outcomes (PSO's):

PSOs are a statement that describes what students are expected to know and be able to do in a specialized area of discipline upon graduation from a program. These are the statements, which are specific to the particular program. They are beyond PO's. Program Curriculum and other activities during the program must help in the achievement of PSOs along with PO's.

Program Educational Objectives (PEO)

(Sample PEO's of Department of Electrical Engineering)

1. Graduates will demonstrate and analyze the fundamental knowledge with respect to the variousdomains of Electrical Engineering.
2. Graduates will investigate and apply modern tools to develop innovativeness in different applications of Electrical Engineering domain.
3. Graduates will integrate new emerging trends and concepts in Electrical Engineering professionfor sustainable development.
4. Graduates will develop professional, managerial and administrative qualities for Electrical Engineering related industries.
5. Graduates will promote lifelong learning in preparing for the next challenges in the field of Electrical Engineering.

2.5 Process for Defining Program Educational Objectives (PEO's) of the Department

Following steps are to be followed to establish the PEO's of Program:

Step 1. The Vision & Mission of the Institute, Department Vision & Mission and Program Outcomes (PO's) is taken as the reference for initiating the process of framing of PEO's of the Program.

Step 2: The Department holds a series of interaction meetings with the stakeholders involved in the process, which include faculty, students, employers, alumni, and parents, in order to obtain the necessary inputs such as technical and generic skills required to sustain in the local as well as global market, as well as Industry Advances in Technology and R & D. A draft copy of the PEO is drafted.

Step 3: The draft framed is checked for consistency with the Institute Vision and Mission, Department Vision & Mission and Program Outcomes and is put up to the Department Quality Assurance Cell (DQAC) for the necessary feedbacks and approvals to present in the Internal Quality Assurance Cell (IQAC).

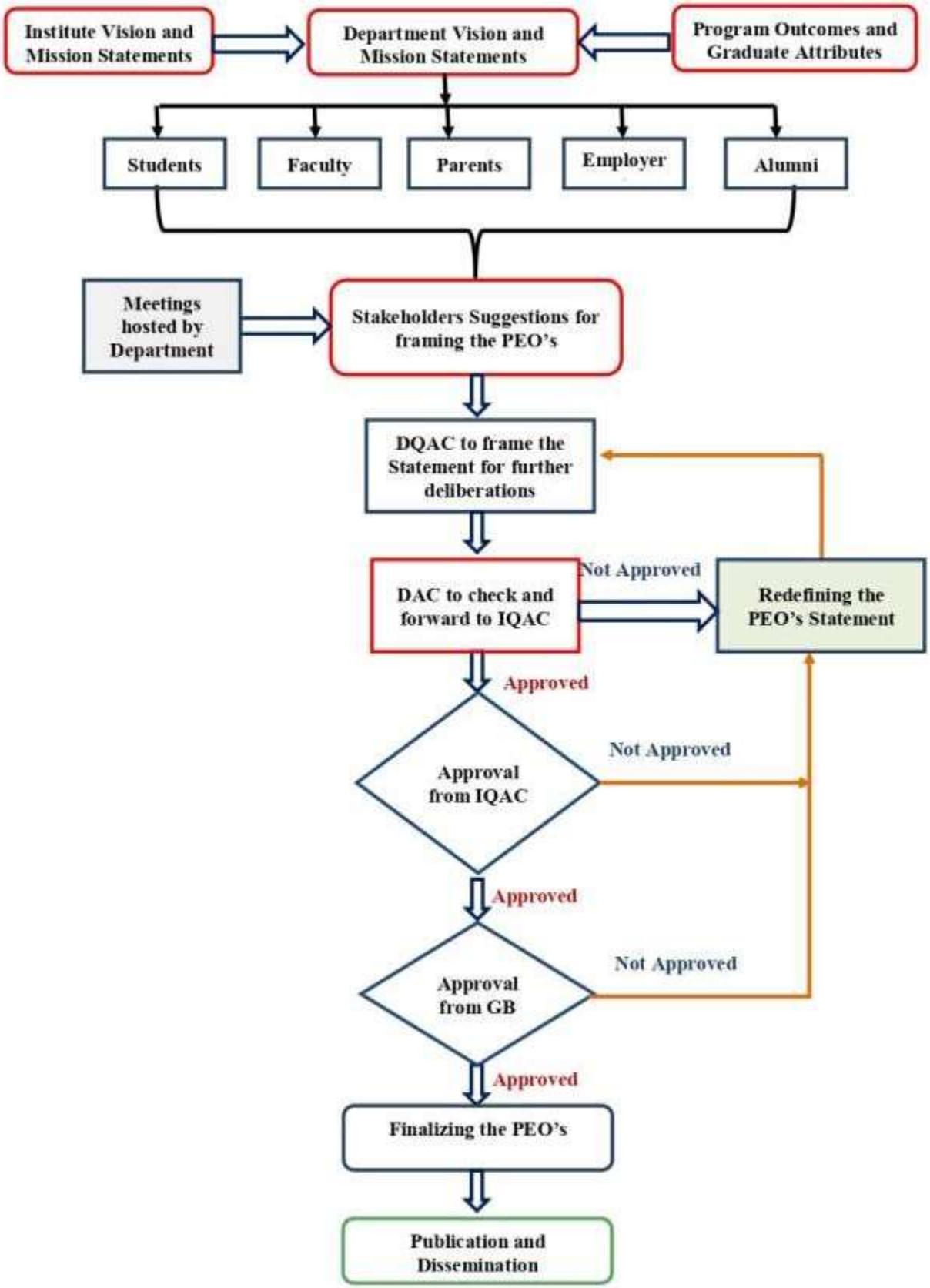
Step 4: IQAC of the institute peruses the PEO's received from the DQAC of the Department and checks the consistency with the Institute Vision and Mission, Department Vision & Mission and Program Outcomes and if required gives a revision of the statement to the respective Department.

Step 5: The approved statements are then presented in the Department Advisory Committee (DAC) for further consent and approvals. DAC gives the consent to IQAC for further actions required for the final approval.

Step 6: IQAC presents the final copy of the statement to the Governing Body (GB) for the final approval and release of the Statement.

Step 7: The process may be repeated in case the GB rejects the statement presented by the IQAC or else in Step 6, GB gives the necessary approvals for the further dissemination of the statements to the stakeholders.

The process for defining department vision and mission are illustrated in the flow chart Figure 2.2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Program Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

(Sample PEO's of Department of Electrical Engineering)

PSO1: Graduates will be able to formulate the solutions to Electrical and Electronics Engineering problems using the basicconcepts.

PSO2: Graduates will be able to develop the process to interpret networks parameters in power system operation and controlwith their protection and driving mechanisms.

PSO3: Graduates will be able to apply project based learning to conduct experiments with Electrical Machines, PowerElectronics to develop energy efficient systems.

The Process for Defining Program Specific Outcomes (PSO's) of the Department:

The following steps are to be followed to establish PSO's of Program:

Step 1. The Vision & Mission of the Institute, Department Vision & Mission and PEO's and PO's is taken as the reference for initiating the process of framing of PSO's of the Program.

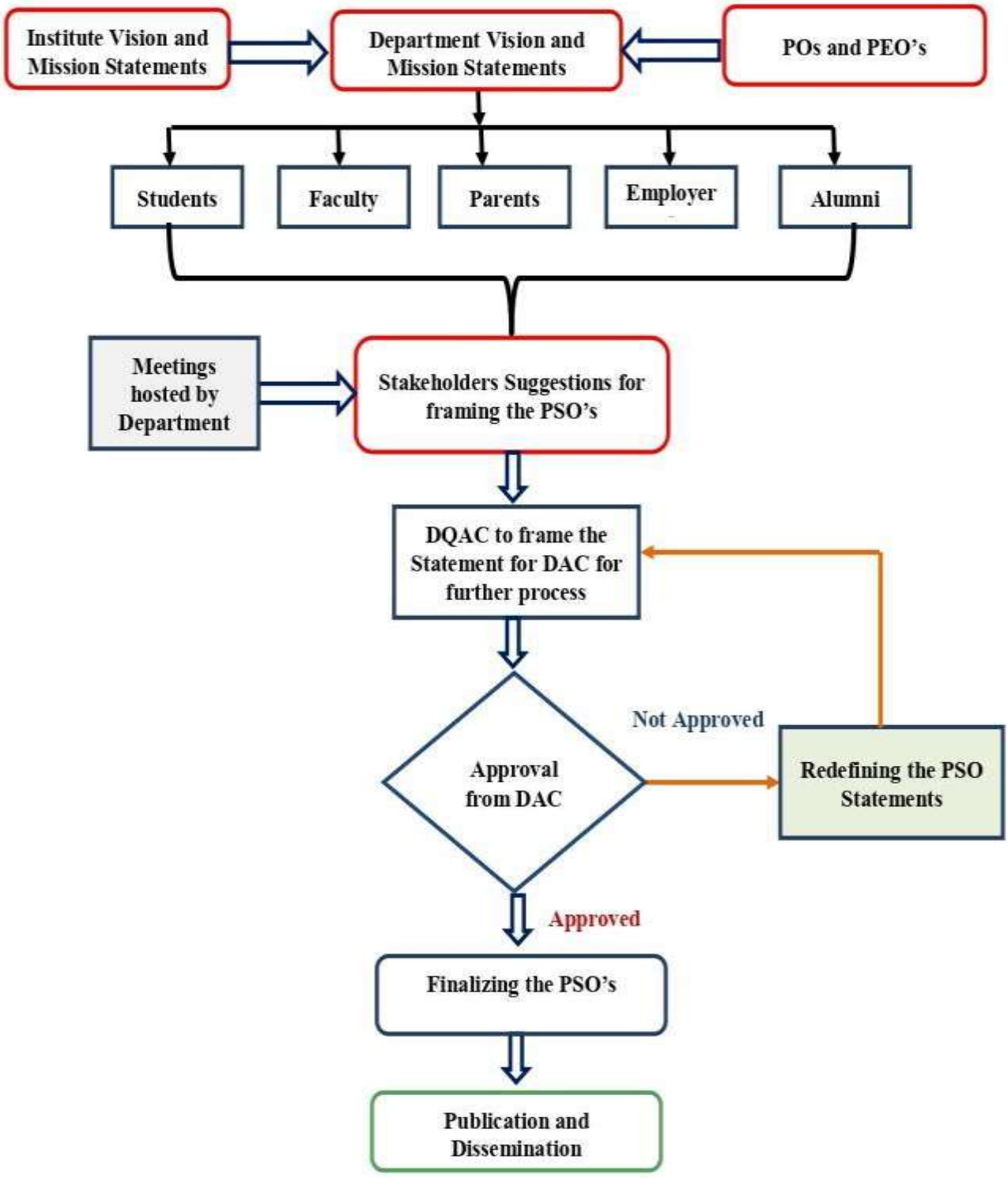
Step 2: The Department hosts a series of interaction meetings with the stakeholders involved in the process which includes, faculty, students, employers, alumni and parents in order to get the required inputs such as technical and generic skills required to sustain in the local as well as global market and Industry Advances in Technology and R & D. A draft copy of the PSO is drafted.

Step 3: The draft framed is checked to be consistent with the Institute Vision and Mission, Department Vision & Mission and Program Outcomes and PEO's and is put in front of the Department Quality Assurance Cell (DQAC) for the necessary feedbacks and approvals to present in the Department Advisory Committee (DAC).

Step 4: The approved statements are then presented in the Department Advisory Committee (DAC) for further consent and approvals. DAC gives the consent for further actions required for the final approval.

Step 5: The process may be repeated in case the DAC rejects the statement presented by the DQAC or else in Step 4, GB gives the necessary approvals for the further dissemination of the statements to the stakeholders.

The process for defining department vision and mission are illustrated in the flow chart Figure 2.3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Chapter 3
Bloom's Taxonomy

The original taxonomy was first described in 1956 in the book Taxonomy of Educational Objectives by American educational psychologist Benjamin Bloom and his coauthors Max Englehart, Edward Furst, Walter Hill, and David Krathwohl. Their book classifies learning goals into one of the categories mentioned above (from Knowledge to Evaluation).Their goal was to provide teachers with a common vocabulary to discuss curricular and evaluation problems with greater precision.
To provide learners with clearer instructional goals, a group of researchers led by Bloom's colleague David Krathwohl and one of Bloom's students, Lorin Anderson, revised the taxonomy in 2001.

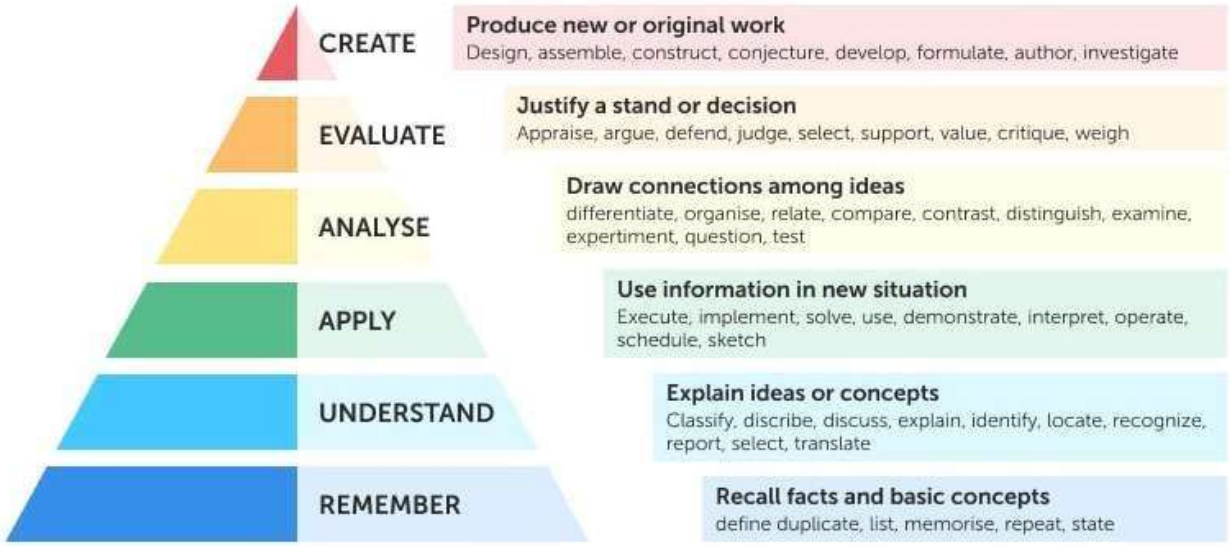


Figure 3.1 Pictorial representation of Blooms Taxonomy

Leve1: Remember

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

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

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

The associated cognitive processes, as already noted, are:

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

historical events).

Level 2: Understand

At this point, learners might be asked to explain a concept in their own words, describe a mathematical graph or clarify a metaphor.

The processes associated with understanding are:

- **Interpreting** implies changing from one form of representation to another. It might be transforming numerical information into verbal.
- **Exemplifying** is finding a specific illustration of a concept or principle. It may be giving several examples of Suprematist paintings.
- **Classifying** is determining a category of something. An example is the classification of mental disorders.
- **Summarizing** means retrieving a general theme of significant points (e.g., writing a short summary of a story).
- **Inferring** is drawing a logical conclusion from given information. It may be formulating grammatical principles of a foreign language from the presented examples.
- **Comparing** is finding correspondences between two ideas or objects (e.g., comparing historical events to their contemporary analogues).
- **Explaining** is constructing a cause-and-effect model of a system, for example, explaining the causes of the French Revolution.

Level 3: Apply

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

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

The processes of cognition corresponding to this stage are:

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

Level 4: Analyze

At this level, students are supposed to break down concepts and examine their relationships.

For instance, they might be asked to recognize the genre of a painting or describe the leading causes of the Great Depression.

The three particular processes associated with this stage are:

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

Level 5: Evaluate

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

They might be asked, for example:

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

Evaluating is divided into checking and critiquing.

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

Level 6: Create

This is the most complex stage of the learning process and the top of the revised Bloom's Taxonomy.

At this level, learners combine known patterns, ideas and facts to create original work or formulate their solution to a problem.

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

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

Chapter 4
Course Outcome Statement

Structure of a Course Outcome (CO) Statement:

A CO statement should be framed using the following components;

I. Action: Represents a cognitive/affective/psychomotor activity the learner should perform. An action is indicated by an action verb, occasionally two, representing the concerned cognitive process (es).

II. Knowledge: Represents the specific knowledge from any one or more of the eight knowledge categories.

III. Condition: Represents the process the learner is expected to follow or the condition under which to perform the action (This is an optional element of a CO).

IV. Criteria: Represent the parameters that characterize the acceptability levels of performing the action (This is an optional element of CO).

Demonstration:

Determine the root of the given equation, accurate to second decimal place, using Newton-Raphson method.

Action: **Determine (Apply)**

Knowledge: **root of the given equation (Conceptual and Procedural)**

Condition: **using Newton – Raphson**

Criterion: **accurate to second decimal place**

Sample Course Outcome Statement of Course: ***Computer Application in Power System***

CO1	**Determine** the incidence matrices for a given power system network.
CO2	**Construct** the Bus Impedance Matrix using Algorithm and Modify the same due to addition or deletion of buses in the power system network.
CO3	**Solve** the Three Phase Network to form the Bus Impedance Matrix.
CO4	**Judge** the Bus Impedance Matrix by inspection and Evaluate the Power Flow Equations using Gauss- Siedel and Newton-Raphson Method.
CO5	**Estimate** the Short Circuit Current during the various faults in the Power System Network.
CO6	**Build** the algorithm to solve the transient stability using Modified Euler Method and Range-Kutta-IV Method.

Number of CO's for a Course:

Generally course should have about 5-6 course outcomes.

The number of CO's of courses carrying different number of credits can be suitably adjusted.

Do's and don'ts

- Use only one action verb
- Do not use words including 'like', 'such as', 'different', 'various', 'etc'. with respect to knowledge elements. Enumerate all the knowledge elements
- Put in all possible efforts to make CO statement as detailed as possible, and measurable.
- Do not make it either too abstract or too specific.

Check List:

- ✓ Does the CO begin with an action verb?
- ✓ Is the CO stated in terms of student performance (rather than teacher performance or coursecontent to be covered)?
- ✓ Is the CO stated as learning product rather than a learning process?
- ✓ Is the CO stated at a proper level of generality, and relatively independent of other Cos?
- ✓ Is the CO attainable in the given context (student's background, prerequisite competencies, facilities, time available and so on?

Chapter 5
CO-PO and CO-PSO Mapping of Course

Strength of CO-PO/PSO Mapping:

- The level (mapping strength) at which a given PO/PSO is addressed by the course must be determined.
- Strength of a mapping is defined at three levels: **Poor (1), Moderate (2) and High (3)**
- Competencies to be attained from each of the Program Outcomes are identified by the four Performance Indicators (PI's) associated with the respective Program Outcomes.
- If all the four PI's identified in the PO Statements for a particular PO is addressed it is considered to be mapped at Level 3 (4/4 = 100%).
- If three out of four PI's identified in the PO Statements for a particular PO is addressed it is considered to be mapped at Level 2 (3/4 = 75%).
- If two out of four PI's identified in the PO Statements for a particular PO is addressed it is considered to be mapped at Level 1 (2/4 = 50%).
- If less than 50% of PI's identified in the PO Statements for a particular PO is addressed it is considered not mapped at any Level.

Program Outcomes (PO's) and their Performance Indicators based on the Competencies defined in the PO Statement are as stated below:

PO Statement	Performance Indicators (PI's)	
PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.	**1.1**	**Knowledge of Mathematics**
	1.2	**Science**
	1.3	**Engineering fundamentals**
	1.4	**Engineering specialization**
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.	**2.1**	**Research literature**
	2.2	**Mathematics**
	2.3	**Natural sciences**
	2.4	**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.	**3.1**	**Public Health and Safety Considerations**
	3.2	**Cultural Considerations**
	3.3	**Societal Considerations**
	3.4	**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.	**4.1**	**Design of Experiments**
	4.2	**Analysis of Data**
	4.3	**Interpretation of Data**
	4.4	**Synthesis of the information**
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.	**5.1**	**Appropriate Techniques**
	5.2	**Create Resources**
	5.3	**Modern Engineering**
	5.4	**IT Tools**
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	**6.1**	**Societal Issues**
	6.2	**Health Issues**
	6.3	**Safety Issues**
	6.4	**Legal or Cultural Issues**
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.	**7.1**	**Societal contexts**
	7.2	**Environmental Contexts**
	7.3	**Knowledge for Sustainable Development**
	7.4	**Need for Sustainable Development**
PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**8.1**	**Ethical Principles**
	8.2	**Professional Ethics**
	8.3	**Responsibilities of Engineering Practice**
	8.4	**Norms of 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.	**9.1**	**Function as Individual**
	9.2	**Function as member**
	9.3	**Function as Leader**
	9.4	**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	**10.1**	**Able to Comprehend**
	10.2	**Write Effective Reports**
	10.3	**Design Documentation**
	10.4	**Make Effective Presentations**
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.	**11.1**	**Leader in Team**
	11.2	**Project**
	11.3	**Multidisciplinary**
	11.4	**Engineering and Management Principle**
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.	**12.1**	**Need of Independent Learning**
	12.2	**Need of Life-Long Learning**
	12.3	**Preparation of Independent Learning**
	12.4	**Preparation of Life-Long Learning**

CO-PSO Mapping:

The process illustrated in 6.2 and 6.3 is to be followed and the CO-PSO Matrix is to be formulated. A sample CO-PSO Mapping of B.E - Electrical Engineering is demonstrated as below:

PSO Statement	Performance Indicators (PI's)	
PSO 1: Formulate the solutions to electrical and electronics engineering problems using basic concepts.	**PSO1.1**	**Problem Formulation**
	PSO1.2	**Solving Problems**
	PSO1.3	**Basic Electrical Knowledge**
	PSO1.4	**Basic Electronics Knowledge**
PSO 2: Develop the process to interpret network parameters in power system operation and control with their protection and driving mechanism.	**PSO2.1**	**Develop the process and interpret**
	PSO2.2	**Determination of Network Parameters**
	PSO2.3	**Power System Operation and Control**
	PSO2.4	**Power System Protection**
PSO 3: Apply project based learning to conduct experiments with electrical machines, power electronics to develop energy efficient system.	**PSO3.1**	**Apply Project Based Learning and Experimentation**
	PSO3.2	**Electrical Machines**
	PSO3.3	**Power Electronics**
	PSO3.4	**Energy Efficient System**

Chapter 6

Illustration of CO-PO- PSO mapping for a course

	Program Outcomes & Program Specific Outcomes Performance Indicators:														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO-1	1.1	2.1	3.1	4.1	5.1	6.1	7.1	8.1	9.1	10.1	11.1	12.1	PSO1.1	PSO2.1	PSO3.1
	1.2	2.2	3.2	4.2	5.2	6.2	7.2	8.2	9.2	10.2	11.2	12.2	PSO1.2	PSO2.2	PSO3.2
	1.3	2.3	3.3	4.3	5.3	6.3	7.3	8.3	9.3	10.3	11.3	12.3	PSO1.3	PSO2.3	PSO3.3
	1.4	2.4	3.4	4.4	5.4	6.4	7.4	8.4	9.4	10.4	12.4	12.4	PSO1.4	PSO2.4	PSO3.4
Keywords	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
CO Statement: xxxxxxx	1	1	-	-	-	-	-	-	-	-	1	1	1	1	-
	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-
	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1
	1	1	1	-	-	-	-	-	-	-	1	1	1	1	1
Total Keywords Addressed	3	4	2	-	-	-	-	-	-	-	2	3	3	4	2
Probability of CO	¾ = 75%	4/4 = 100%	2/4= 50%	-	-	-	-	-	-	-	2/4 = 50%	¾ = 75%	¾ = 75%	4/4 = 100%	2/4 = 50%
Mapping Strength	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**3**	**1**

Demonstrations:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Apply Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehend	Leader in Team	Need of Independent Learning
Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Documentation	Multidiciplinary	preparation of Independent Learning
Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisciplinary Settings	Make Effective Presentations	Engineering and Management Principle	Preparation of Life-Long Learning

PSO1	PSO2	PSO3
Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
Solving Problems	Determination of Network Parameters	Electrical Machines
Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
Basic Electronics Knowledge	Power System Protection	Energy Efficient System

Sample CO-PO and CO-PSO Mapping

CO-PO Mapping of Course:- Electrical Power System -I

	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communi cate	Demonstrate	Recognize
CO1(TH)	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehe nd	Leader in Team	Need of Independent Learning
	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Document ation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentati ons	Engineering and Management Principle	Preparation of Life-Long Learning
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Demonstrate the structure of Electrical Power System and substation.	1	1	1	-	-	-	-		-		-	1
	1	1	-	1	-	-	-	-	-	-		1
	1	1	-	1	-	-	-			-		1
	1	1	1	1	-	-				-		1
Total Number of PO Keywords addressed by the CO	4	4	2	3	0	0	0	0	0	0	0	4
Probability of CO	1	1	0.5	0.75	0	0	0	0	0	0	0	1
Mapping Strength	3	3	1	2	-	-	-	-	-	-	-	3

CO2(TH)	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communi cate	Demonstrate	Recognize
	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehe nd	Leader in Team	Need of Independent Learning
	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Document ation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentati ons	Engineering and Management Principle	Preparation of Life-Long Learning
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Model the components of power system using per unit system.	1	1	-	1	1	-	-		-		-	1
	1	1	-	1	-	-	-	-		-		1
	1	1	-	1	1	-	-			-		1
	1	-	-	1	-	-				-		1
Total Number of PO Keywords addressed by the CO	4	3	0	4	2	0	0	0	0	0	0	4
Probability of CO	1	0.75	0	1	0.5	0	0	0	0	0	0	1
Mapping Strength	3	2	-	3	1	-	-	-	-	-	-	3

CO3(TH)	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communi cate	Demonstrate	Recognize
	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehe nd	Leader in Team	Need of Independent Learning
	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Document ation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentati ons	Engineering and Management Principle	Preparation of Life-Long Learning
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Explain the Feeders and distributors in Elementary distribution scheme.	1	1	1	1	1	-	-		-		-	1
	1	1	-	1	-	-	-	-		-		1
	1	1	-	1	1	-	-			-		1
	1	1	1	1	-	-				-		1
Total Number of PO Keywords addressed by the CO	4	4	2	4	2	0	0	0	0	0	0	4
Probability of CO	1	1	0.5	1	0.5	0	0	0	0	0	0	1
Mapping Strength	3	3	1	3	1	-	-	-	-	-	-	3

	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communi cate	Demonstrate	Recognize
	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehe nd	Leader in Team	Need of Independent Learning
	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Document ation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentati ons	Engineering and Management Principle	Preparation of Life-Long Learning
CO4(TH)												
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Illustrate the concept of designing the parameters of transmission lines using T and pi representation	1	1	-	-	-	-	-		-		-	1
	1	1	-	1	-	-	-	-		-		1
	1	1	-	-	-	-	-			-		1
	1	1	-	1	-	-				-		1
Total Number of PO Keywords addressed by the CO	4	4	0	2	0	0	0	0	0	0	0	4
Probability of CO	1	1	0	0.5	0	0	0	0	0	0	0	1
Mapping Strength	3	3	-	1	-	-	-	-	-	-	-	3

	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communi cate	Demonstrate	Recognize
	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehe nd	Leader in Team	Need of Independent Learning
CO5(TH)	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Document ation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentati ons	Engineering and Management Principle	Preparation of Life-Long Learning
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Classify the types of buses used in load flow analysis of power system	1	1	1	1	1	-	-		-		-	1
	1	1		1	-	-	-	-		-		1
	1	1	-	1	1	-	-			-		1
	1	1	1	1	1	-				-		1
Total Number of PO Keywords addressed by the CO	4	4	2	4	3	0	0	0	0	0	0	4
Probability of CO	1	1	0.5	1	0.75	0	0	0	0	0	0	1
Mapping Strength	3	3	1	3	2	-	-	-	-	-	-	3

CO6(TH)	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Apply	Identify	Design/Develop	Conduct Investigations	Create/ Design/Apply	Apply	Understand	Apply / Commit	Function	Communicate	Demonstrate	Recognize
	Knowledge of Mathematics	Research literature	Public Health and Safety Considerations	Design of Experiments	Appropriate Techniques	Societal Issues	Societal contexts	Ethical Principles	Function as Individual	Able to Comprehend	Leader in Team	Need of Independent Learning
	Science	Mathematics	Cultural Considerations	Analysis of Data	Create Resources	Health Issues	Environmental Contexts	Professional Ethics	Function as member	Write Effective Reports	Project	Need of Life-Long Learning
	Engineering fundamentals	Natural sciences	Societal Considerations	Interpretation of Data	Modern Engineering	Safety Issues	Knowledge for Sustainable Development	Responsibilities of Engineering Practice	Function as Leader	Design Documentation	Multidicip linary	preparation of Independent Learning
	Engineering specialization	Engineering sciences	Environmental Considerations	Synthesis of the Information	IT Tools	legal or Cultural Issues	Need for Sustainable Development	Norms of Engineering Practice	Multidisip ilnary Settings	Make Effective Presentations	Engineering and Management Principle	Preparation of Life-Long Learning
Total Keyword →	4	4	4	4	4	4	4	4	4	4	4	4
Discuss the concept of real & reactive power control , automatic voltage regulator	1	1	-	-	-	-	-		-		-	1
	1	1	-	1	-	-	-	-		-		1
	1	1	-	-	-	-	-			-		1
	1	1	-	1	-	-				-		1
Total Number of PO Keywords addressed by the CO	4	4	0	2	0	0	0	0	0	0	0	4
Probability of CO	1	1	0	0.5	0	0	0	0	0	0	0	1
Mapping Strength	3	3	-	1	-	-	-	-	-	-	-	3

CO1(TH)	Program Specific Outcomes		
	PSO1	PSO2	PSO3
	Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
	Solving Problems	Determination of Network Parameters	Electrical Machines
	Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
	Basic Electronics Knowledge	Power System Protection	Energy Efficient System
Total Keyword →	4	4	4
Demonstrate the structure of Electrical Power System and substation.	1	-	1
	1	1	-
	1	1	-
	1	1	1
Total Number of PO Keywords addressed by the CO	4	3	2
Probability of CO	1	0.75	0.5
Mapping Strength	3	2	1

CO2(TH)	Program Specific Outcomes		
	PSO1	PSO2	PSO3
	Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
	Solving Problems	Determination of Network Parameters	Electrical Machines
	Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
	Basic Electronics Knowledge	Power System Protection	Energy Efficient System
Total Keyword →	4	4	4
Model the components of power system using per unit system.	1	1	-
	1	1	-
	1	1	-
	1	1	-
Total Number of PO Keywords addressed by the CO	4	4	0
Probability of CO	1	1	0
Mapping Strength	3	2	-

CO3(TH)	Program Specific Outcomes		
	PSO1	**PSO2**	**PSO3**
	Problem Formulation	**Develop the process and interpret**	**Apply Project Based Learning and Experimentation**
	Solving Problems	**Determination of Network Parameters**	**Electrical Machines**
	Basic Electrical Knowledge	**Power System Operation and Control**	**Power Electronics**
	Basic Electronics Knowledge	**Power System Protection**	**Energy Efficient System**
Total Keyword →	4	4	4
Explain the Feeders and distributors in Elementary distribution scheme.	1	**1**	**-**
	1	**1**	**-**
	1	**-**	**-**
	1	**1**	**-**
Total Number of PO Keywords addressed by the CO	**4**	**3**	**0**
Probability of CO	**1**	**0.75**	**0**
Mapping Strength	**3**	**2**	**-**

CO4(TH)	Program Specific Outcomes		
	PSO1	PSO2	PSO3
	Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
	Solving Problems	Determination of Network Parameters	Electrical Machines
	Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
	Basic Electronics Knowledge	Power System Protection	Energy Efficient System
Total Keyword →	4	4	4
Illustrate the concept of designing the parameters of transmission lines using T and pi representation	1	1	-
	1	1	-
	1	-	-
	1	1	-
Total Number of PO Keywords addressed by the CO	4	3	0
Probability of CO	1	0.75	0
Mapping Strength	3	2	-

CO5(TH)	Program Specific Outcomes		
	PSO1	PSO2	PSO3
	Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
	Solving Problems	Determination of Network Parameters	Electrical Machines
	Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
	Basic Electronics Knowledge	Power System Protection	Energy Efficient System
Total Keyword →	4	4	4
Classify the types of buses used in load flow analysis of power system	1	1	1
	1	1	-
	1	-	-
	1	1	1
Total Number of PO Keywords addressed by the CO	4	3	2
Probability of CO	1	0.75	0.5
Mapping Strength	3	2	1

CO6(TH)	Program Specific Outcomes		
	PSO1	PSO2	PSO3
	Problem Formulation	Develop the process and interpret	Apply Project Based Learning and Experimentation
	Solving Problems	Determination of Network Parameters	Electrical Machines
	Basic Electrical Knowledge	Power System Operation and Control	Power Electronics
	Basic Electronics Knowledge	Power System Protection	Energy Efficient System
Total Keyword →	4	4	4
Discuss the concept of real & reactive power control , automatic voltage regulator	1	1	1
	1	1	-
	1	-	-
	-	1	1
Total Number of PO Keywords addressed by the CO	3	3	2
Probability of CO	0.75	0.75	0.5
Mapping Strength	2	2	1

Course Outcomes	Program Outcomes & Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	-	-	-	-	-	-	-	3	3	2	1
CO2	3	2	-	3	1	-	-	-	-	-	-	3	3	3	-
CO3	3	3	1	3	1	-	-	-	-	-	-	3	3	2	-
CO4	3	3	-	1	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	1	3	2	-	-	-	-	-	-	3	3	2	1
CO6	3	3	-	1	-	-	-	-	-	-	-	3	2	2	1
Average	**3.00**	**2.83**	**1.00**	**2.17**	**1.33**	**-**	**-**	**-**	**-**	**-**	**-**	**3.00**	**2.83**	**2.16**	**1.00**

The above illustration is for one course. The same procedure is to be followed for the formation of CO-PO –PSO mapping of all the courses in a Program. The summary of all the courses in a single table forms the course articulation matrix

Chapter 7
Curricular Gaps Identification Process

CO-PO-PSO Mapping for the course forms the basis for the identification of the curricular gaps.

Following process is adopted for the identification of the curricular gaps:

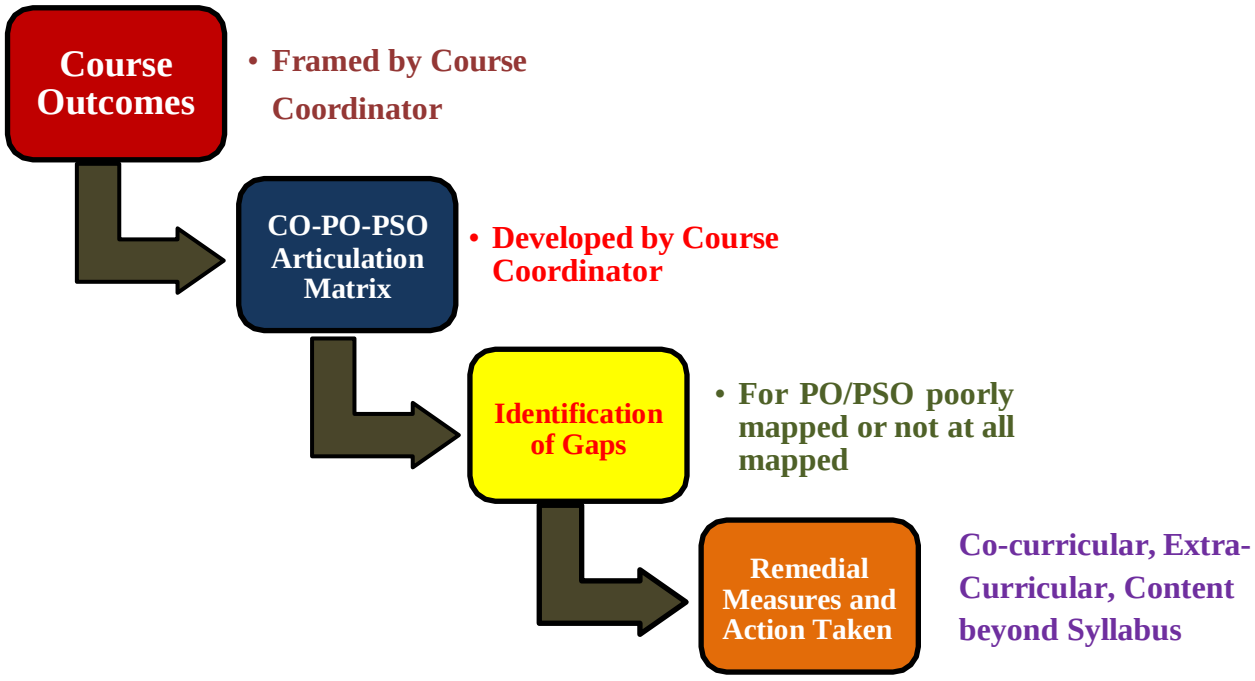
Step 1: Course coordinator frames the Course Outcomes based on the methodology given in the manual.

Step 2: Course coordinator articulates the CO-PO-PSO Matrix by following the process mentioned in the manual.

Step 3: Identifies the PO and PSO which are either poorly mapped or not at all mapped with the Course Outcomes.

Step 4: Takes the remedial measures or actions to map the respective PO/PSO identified in the Step 3 with the help of co-curricular, extra-curricular and content beyond syllabus.

Step 5: Validation of the CO-PO-PSO Matrix and the Curricular Gaps is done by the **Program Head at Program Level and by IQAC at Institute Level.**



Chapter 8
Attainment Process of Course Outcomes

8.1 Attainment of CO's (University Curriculum)

Assessment processes:

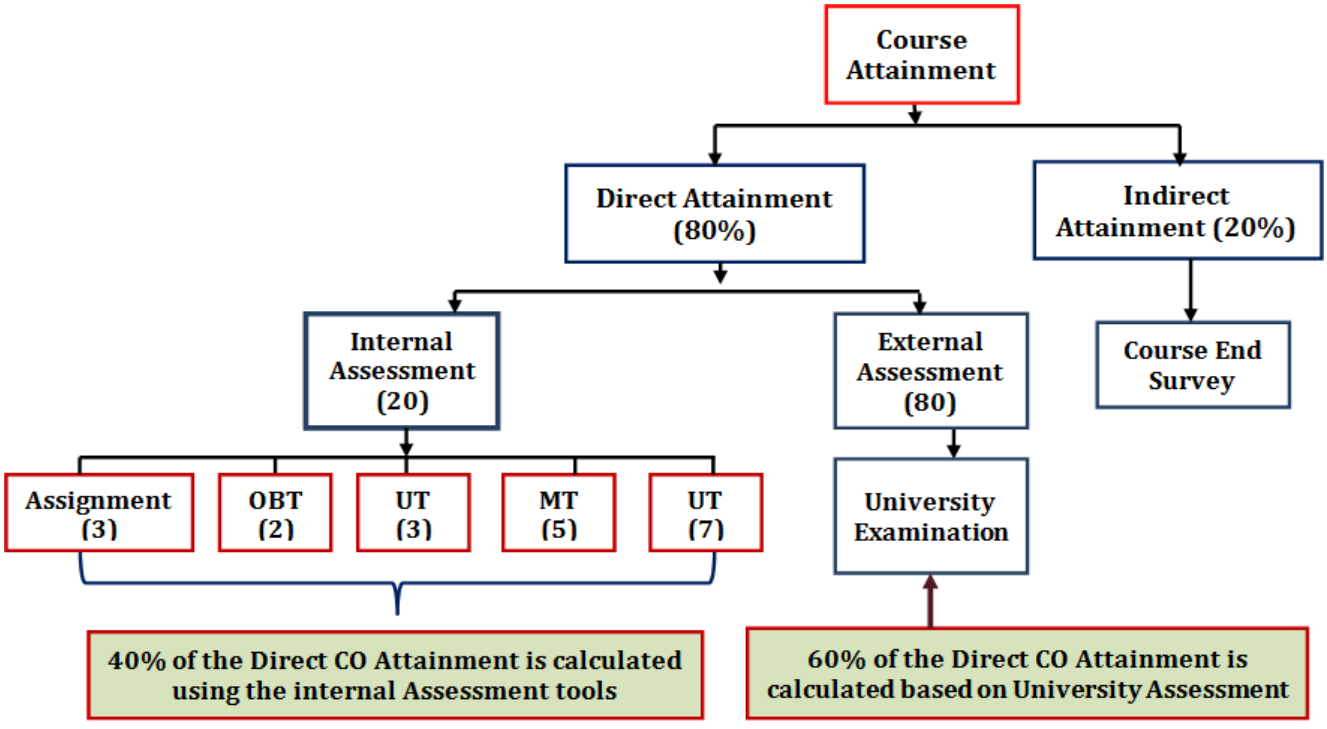
As per the affiliated university (Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur) directions the assessment of students is comprised of:

	Internal Assessment (IA)	University Assessment (UA)
Theory Courses	20 Marks	80 Marks
Practical Courses	25 Marks	25 Marks
Project Seminar	50 Marks	-
Project	75 Marks	75 Marks

Based on the above assessment methodology, course outcome attainment tools are developed for the calculation of the Course Attainment.

I. Theory Courses:

The assessment tool for the course outcome attainment of theory courses is explained below;



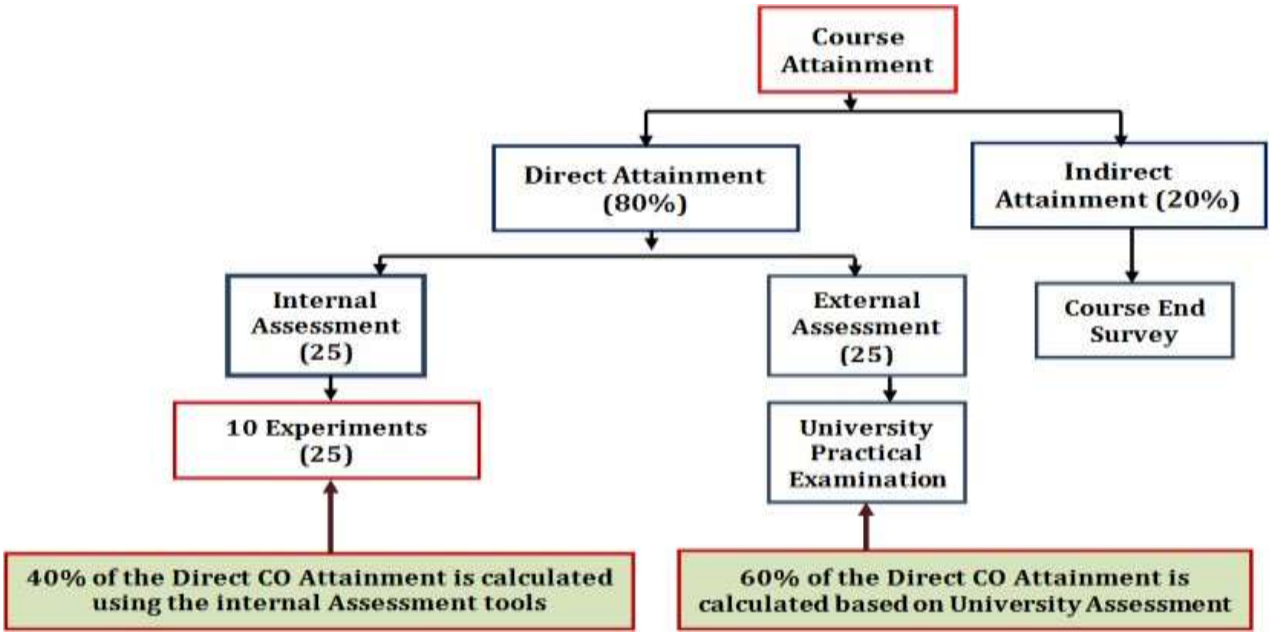
- The Course Attainment of Theory courses comprises of 80% based on the Direct Attainment and 20 % on the Indirect Attainment.
- Direct Attainment of the Theory Courses is based on the evaluation of the Internal Assessment for 20 Marks and External Assessment for 80 Marks conducted by the University Examinations.
- Indirect Attainment of the Theory Courses is based on the course end survey.

Summary of Assessment Tools for the Internal Assessment of Theory Courses:

Sr. No.	Description of Tool	Assessment Criterion	Process for Data collection
1.	Assignment (3M)	Three Assignments are to be submitted, based on all CO's units of the syllabus of 10 M (5 M each on respective CO).	Evaluated copies and score of students on each assignment. Cumulative conversion out of 3.
2.	Open Book Test (2M)	Three OBT each of CO-4, CO-5 and CO-6 of the course for 10 M each.	Evaluated answer books and score of students on each OBT. Cumulative conversion out of 2.
3.	Unit Test (3M)	Conduction of Unit Test on CO-1 of the course for 13M, 20M **(in case of Online Mode)**	Evaluated answer books and score of students of UT. Conversion out of 3.
4.	Mid Term Examination (5M)	Conduction of Mid Term Examination on CO-2, CO-3 of the course for 26M, 40M **(in case of Online Mode)**	Evaluated answer books and score of students of MT. Conversion out of 5.
5.	End Term Examination (7M)	Conduction of End Term Examination on the entire CO's of the course for 80 Marks.	Evaluated answer books and score of students of ET. Conversion out of 7.

II. Practical Courses:

The assessment tool for the course outcome attainment of practical courses is explained below;



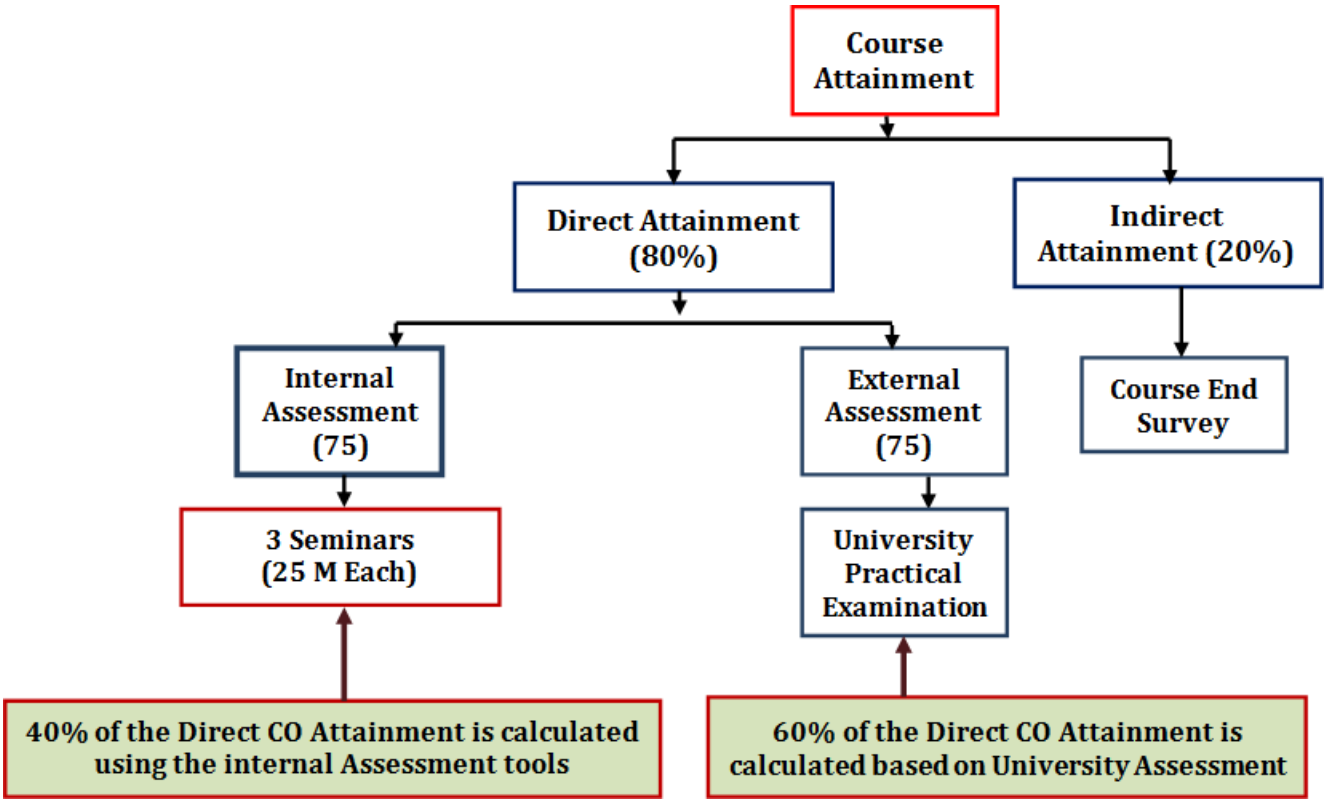
- The Course Attainment of Practical courses comprises of 80% based on the Direct Attainment and 20 % on the Indirect Attainment.
- Direct Attainment of the Theory Courses is based on the evaluation of the Internal Assessment for 25 Marks and External Assessment for 25 Marks conducted by the University Examinations.
- Indirect Attainment of the Practical Courses is based on the course end survey.

Summary of Assessment Tools for the Internal Assessment of Practical Courses:

Sr. No.	Description of Tool	Assessment Criterion	Process for Data collection
1.	Experiments (25M)	Ten Experiments are to be performed. Five CO's are equally mapped with each experiment. Each Experiment comprises of 25 Marks **(Rubrics of evaluation are defined based on the Cognitive, Affective and Psychomotor domain)**	Evaluated copies and score of students on each practical. Cumulative conversion out of 25 Marks.

III. Project Courses:

The assessment tool for the course outcome attainment of project courses is explained below;



- The Course Attainment of project courses comprises of 80% based on the Direct Attainment and 20 % on the Indirect Attainment.
- Direct Attainment of the project Courses is based on the evaluation of the Internal Assessment for 75 Marks and External Assessment for 75 Marks conducted by the University Examinations.
- Indirect Attainment of the Practical Courses is based on the course end survey.

Summary of Assessment Tools for the Internal Assessment of Project Courses:

Sr. No.	Description of Tool	Assessment Criterion	Process for Data collection
1.	**Progress Seminar (75M)**	Three Progress Seminars are to be delivered by students. Five CO's are equally mapped with each seminar. Each seminar comprises of 25 Marks **(Rubrics of evaluation are defined based on the Cognitive, Affective and Psychomotor domain)**	Evaluated copies and score of students on each seminar. Evaluated Marks out of 75 Marks.

IV. Assessment Levels of the Course Outcome Attainment:

The following Criteria are defined for the Attainment of Course Outcomes;

A. Internal Assessment:

Threshold benchmark is considered based on the students' performance in the internal assessment tools and the previous year's attainments of the course outcomes.

i) Benchmark Levels for theory, practical and project Courses:

Sr. No.	Set Benchmark	Level
1	Upto 50% of the student scoring more than threshold	**1**
2	50.01 to 70% of the student scoring more than threshold	**2**
3	Above 70 % of the student scoring more than threshold	**3**

B. External Assessment:

Benchmark is considered based on the students' performance in the University Examination. The average marks scored by the students under assessment are calculated, number of scoring above the average marks is considered for setting the benchmark for Attainment. Further, this benchmark varies with the year of progression. The values of the benchmarks are as given below;

Sr. No.	Set Benchmark (2017-18)	Level
1	40% of the student more than Average Marks	1
2	50% of the student more than Average Marks	2
3	60% of the student more than Average Marks	3

Sr. No.	Set Benchmark (2018-19)	Level
1	45% of the student more than Average Marks	**1**
2	55% of the student more than Average Marks	**2**
3	65% of the student more than Average Marks	**3**

Sr. No.	Set Benchmark (2019-20)	Level
1	50% of the student more than Average Marks	**1**
2	60% of the student more than Average Marks	**2**
3	70% of the student more than Average Marks	**3**

Sr. No.	Set Benchmark (2021-22)	Level
1	55% of the student more than Average Marks	**1**
2	65% of the student more than Average Marks	**2**
3	75% of the student more than Average Marks	**3**

35	3EE35	Mayur Kishor Lende	70.24	54.86	68.49	65.38	66.15	54.28
36	3EE36	Pawan Ulhas Junghare	72.81	84.60	64.20	72.05	62.05	60.47
37	3EE37	Prasanna Ganesh Lokhande	82.04	73.83	45.63	73.07	73.07	75.71
38	3EE38	Pratik Bhujang Motghare	43.07	62.55	72.88	73.07	63.59	63.80
39	3EE39	Rahul Arun Navghade	89.73	75.37	85.70	76.15	76.15	70.47
40	3EE40	Rajkumar Buchanna Kummari	65.12	80.50	72.36	56.15	46.67	75.23
41	3EE41	Shubham Vasantrao Gomase	61.01	55.89	57.35	67.17	52.82	49.52
42	3EE42	Somant Devrao Durge	58.45	66.14	57.35	67.94	73.84	65.71
43	3EE43	Vinod Kondaiah Medijerla	65.12	77.93	73.25	66.15	67.17	65.71
44	3EE44	Yewakdas Komandas Dahare	58.45	73.83	64.67	70.51	50.25	49.52
Threshold =70%								
Total Number of Student above threshold			23	30	24	26	21	23
% of student above threshold			52.27	68.18	54.55	59.09	47.73	52.27
Level of Atttainment			2	2	2	2	1	2

Sr. No.	Set Benchmark	Level
1	Upto 50% of the student scoring more than threshold (70%)	1
2	51 to 70% of the student scoring more than threshold (70%)	2
3	Above 70% of the student scoring more than threshold (70%)	3

40	Rajkumar Buchanna Kummari	26
41	Shubham Vasantrao Gomase	AA
42	Somant Devrao Durge	41
43	Vinod Kondaiah Medijerla	34
44	Yewakdas Komandas Dahare	32
Average Marks		**33**
Total Number of Students scores More than Average Marks (15)		23
Percentage of student score more than average marks (15)		60.53%

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Sr. No.	Set Benchmark (2019-20)	Level
1	50% of the student scoring more than Average Marks	1
2	60% of the student scoring more than Average Marks	2
3	70% of the student scoring more than Average Marks	3

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Internal CO Attainment (Direct)	2.00	2.00	2.00	2.00	1.00	2.00
University Exam CO Attainment (Direct)	2.00	2.00	2.00	2.00	2.00	2.00
Total Direct Attainment for Theory Course (40% of Internal CO Attainment + 60% University Exam CO Attainment	2.00	2.00	2.00	2.00	1.60	2.00

Total CO Attainment

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Total Direct CO Attainment	2.00	2.00	2.00	2.00	1.60	2.00
Total Indirect CO Attainment	3.00	3.00	2.00	2.00	2.00	2.00
Total CO Attainment for Theory Course (80% of Total Direct CO Attainment + 20% of Total Indirect CO Attainment	2.20	2.20	2.00	2.00	1.68	2.00

8.2. Record the attainment of Course Outcomes of all courses

CO	Course Name	CO1	CO2	CO3	CO4	CO5	CO6
Semester I							
BESI-1T	Applied Mathematics-I	2.52	2.52	1.88	2.52	2.52	2.20
BSEI-2T	Engineering Physics	2.52	2.52	2.52	2.52	-	-
BSEI-3T	Engineering Chemistry	2.04	2.04	2.04	2.04	-	-
BSEI-4T	Basic Electrical Engineering	2.20	2.52	2.20	2.52	-	-
BSEI-5T	Basics of Civil Engineering	2.52	2.32	2.52	2.32	-	-
BSEI-6T	Engineering Graphics-I	2.04	1.84	2.04	2.04	-	-
BSEI-2P	Engineering Physics Lab	2.52	2.52	2.52	2.52	-	-
BSEI-3P	Engineering Chemistry Lab	2.52	2.52	2.52	2.52	-	-
BSEI-4P	Basic Electrical Engineering Lab	2.52	2.52	2.52	2.32	-	-
BSEI-6P	Engineering Graphics Lab	2.52	2.52	2.52	2.32	-	-
BSEI-7T	Communication Skill	2.52	2.52	2.52	2.52	2.52	-
Semester II							
BSEII-1T	Applied Mathematics-II	2.20	1.88	1.88	2.52	2.20	2.52
BSEII-2T	Advance Physics	3.00	3.00	3.00	2.20	-	-
BSEII-3T	Material Chemistry	2.52	2.52	2.52	2.52	-	-
BSEII-4T	Engineering Mechanics	2.04	1.84	2.04	1.84	-	-
BSEII-5T	Advance Electrical Engineering	2.52	2.52	2.52	2.52	-	-
BSEII-6T	Engineering Graphics-II	2.52	2.52	2.52	2.32	-	-
BSEII-2P	Advance Physics Lab	2.52	2.52	2.52	2.52	-	-
BSEII-3P	Material Chemistry Lab	2.68	3.00	3.00	3.00	-	-
BSEII-4P	Engineering Mechanics	2.04	2.04	2.04	1.84	-	-
BSEII-7T	Workshop	2.52	2.52	2.52	2.52	-	-
BSEII-8T	Applied Mathematics-II	2.20	1.88	1.88	2.52	2.20	2.52
Semester III							
BEELE301T	Applied Mathematics-III	1.72	2.04	1.52	1.84	1.20	1.32
BEELE302T	Non Conventional Energy Sources	2.20	2.52	2.00	2.32	1.68	1.80
BEELE303T	Electrical Measurement & Instrumentation	1.82	2.31	1.74	1.94	1.30	1.52
BEELE303P	Electrical Measurement & Instrumentation Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE304T	Network Analysis	1.76	2.12	1.54	1.98	1.24	1.34
BEELE304P	Network Analysis Lab	2.04	2.04	1.84	1.84	1.84	-
BEELE305T	Electronic Devices & Circuits	1.78	2.32	1.58	1.92	1.46	1.68
BEELE305P	Electronic Devices & Circuits Lab	2.04	2.04	1.84	1.84	1.84	-
Semester IV							
BEELE401T	Applied Mathematics-IV	1.82	2.46	1.68	1.74	1.36	1.42
BEELE402T	Elements of Electromagnetics	1.72	2.04	1.52	1.84	1.20	1.32
BEELE403T	Digital and Linear Electronics Circuits	1.86	2.26	1.78	1.64	1.48	1.56
BEELE403P	Digital and Linear Electronics Circuits Lab	2.04	2.04	1.84	1.84	1.84	-
BEELE404T	Electrical Machine-I	1.76	2.14	1.52	1.84	1.20	1.32
BEELE404P	Electrical Machine-I Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE405T	Computer Programming	1.72	2.04	1.52	1.84	1.20	1.32

BEELE405P	Computer Programming Lab	2.04	2.04	1.84	1.84	1.84	-
Semester V							
BEELE501T	Electrical Power System-I	2.20	2.20	2.00	2.00	1.68	2.00
BEELE502T	Utilization of Electric Energy	2.04	2.04	1.52	1.84	1.52	1.52
BEELE503T	Electrical Machine Design	2.04	2.04	1.72	2.04	1.72	1.72
BEELE504T	Microprocessor & Interfacing	1.72	1.52	1.52	1.72	1.20	1.72
BEELE504P	Microprocessor & Interfacing Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE505T	Electrical Machine-II	1.84	1.84	1.52	2.04	1.72	1.72
BEELE505P	Electrical Machine-II Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE506P	Electrical Drawing & Simulation	2.52	2.52	2.32	2.32	2.52	-
BEELE507P	Electrical Engineering Workshop	2.52	2.52	2.32	2.32	2.52	-
Semester VI							
BEELE601T	Power Station Practice	1.72	1.72	1.52	1.52	1.20	1.20
BEELE602T	Engineering Economics & Industrial Management	1.20	1.72	1.52	1.72	1.40	1.20
BEELE603T	Electrical Drives & Their Control	1.72	1.72	1.20	1.40	1.40	1.20
BEELE604T	Power Electronics	1.72	2.04	1.84	1.84	1.52	1.52
BEELE604P	Power Electronics Lab	2.04	2.04	1.84	1.84	1.84	-
BEELE605T	Control System-I	1.72	2.04	1.72	1.52	1.52	1.40
BEELE605P	Control System-I Lab	2.04	2.04	1.84	1.84	1.84	-
BEELE606P	Industrial Visits & Report Writing	3.00	3.00	3.00	3.00	2.80	-
BEELE607T	Functional English	2.20	2.20	2.20	2.00	-	-
Semester VII							
BEELE701T	Control System -II	2.04	2.04	2.04	1.72	1.52	1.52
BEELE702T	Electrical Power System-II	2.52	2.52	2.52	2.20	2.00	2.00
BEELE703T	Elective-I Energy Management & Audit	2.52	2.52	2.52	2.52	2.32	2.32
BEELE704T	High Voltage Engineering	2.52	2.52	2.32	2.52	2.32	2.32
BEELE704P	High Voltage Engineering Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE705T	Electrical Installation Design	2.52	2.52	2.32	2.52	2.32	2.32
BEELE705P	Electrical Installation Design Lab	2.52	2.52	2.32	2.32	2.32	-
BEELE706P	Project Seminar	3.00	3.00	3.00	2.80	2.80	-
Semester VII							
BEELE801T	Elective-II Electrical Distribution System	2.04	2.04	2.04	1.72	1.52	1.52
BEELE802T	Elective-III EHV AC and HVDC Transmission	2.04	2.04	2.04	1.72	1.52	1.52
BEELE803T	Switchgear & Protection	2.52	2.52	2.52	2.20	2.00	2.00
BEELE803P	Switchgear & Protection Lab	2.52	2.52	2.32	2.32	2.52	-
BEELE804T	Computer Application in Power System	2.04	2.04	2.04	1.72	1.52	1.52
BEELE804P	Computer Application in Power System Lab	2.52	2.52	2.32	2.32	2.52	-
BEELE805P	Project	2.52	2.52	2.52	2.52	2.52	-

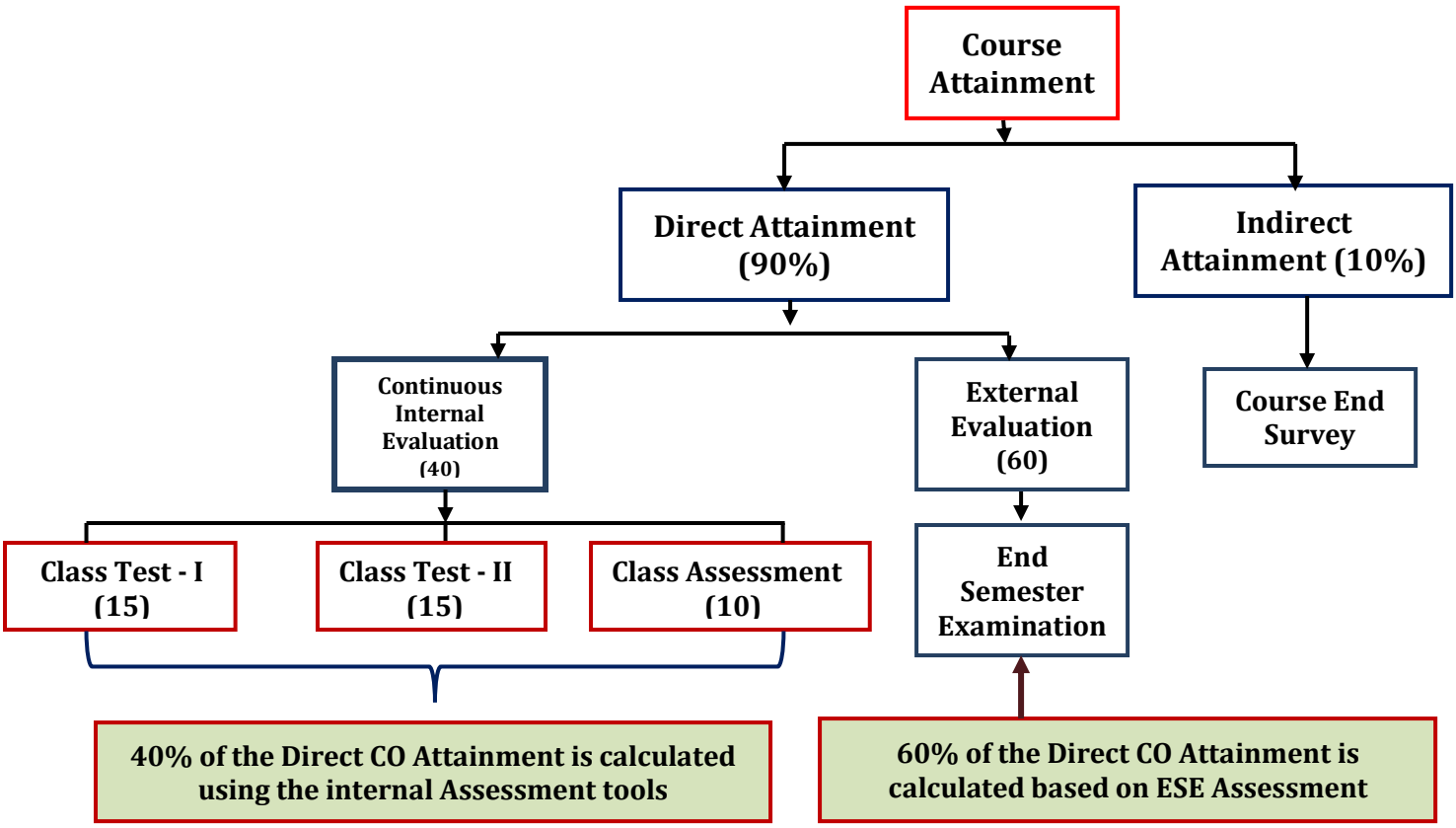
8.3 Attainment of CO's (R21 Autonomous Curriculum of TGPCET)

8.3.1 Summary of Assessment Tool:

Assessment Tools	Assessment Criterion	Process for Data Collection
Class Test – 1 (CT-1)	CT – 1 is based on first two units of the syllabus. There are two sections in the paper. Section – A Two questions each based on Unit – 1 and Unit – 2 respectively, basically consists of short answer question. Section – B. Two question each having three sub-questions from Unit – 1 and Unit – 2 respectively for 4 marks each. Any two is to be solved out of the three sub-questions.	Evaluation of the test copies and the score of the students out of 20, to be converted out of 15.
Class Test – 2 (CT-2)	CT – 2 is based on first three units of the syllabus. There are two sections in the paper. Section – A Two questions each based on Unit – 3, Unit – 4 and Unit – 5 respectively, basically consists of short answer question. Section – B. Three question each having three sub-questions from Unit – 4, Unit – 5 and Unit – 6 respectively for 4 marks each. Any two is to be solved out of the three sub-questions.	Evaluation of the test copies and the score of the students out of 30, to be converted out of 15.
Class Assessment (CA)	CA is to be conducted on all the Units by the course co-ordinator. Activity Based Tools shall be adopted to bridge the curricular gaps using innovative assessment tools. Rubrics of assessment needs to be displayed before the assessment. Two Assessment may be taken and best out of two shall be considered for the final evaluation.	Evaluated copies of the Assignment / Activity / Reports etc and the marks obtained by students out of 10.
End Semester Examination (ESE)	ESE is based on all units of the syllabus. There are two sections in the paper. Section – A Five questions based on each Units from 1 to 5 respectively, basically consists of short answer question. Section – B. Five question each having three sub-questions from Unit – 1 to Unit – 5 for 5 marks each. Any two is to be solved out of the three sub-questions.	Evaluation of the answer books solved by students and marks scored by students out of 60.
Projects	Progress Seminars are conducted during the session and the performance is evaluated by the guide and the reviewers based on the rubrics.	Rubrics Evaluation Sheet.

Attainment of COs:

- COs Attainment can be measured both directly and indirectly.
- The performance of students in all applicable assessment instruments can be used to determine direct attainment of COs.
- The course exit survey can be used to determine indirect CO attainment (which is optional according to NBA).
- The exit survey form should allow students to provide comments on the entire COs.
- The computation of indirect CO achievement is based on student perceptions. As a result, thepercentage weighting given to indirect accomplishment can be maintained modest, say 10%.



8.3.2 Course Attainment Level (Target)

Assessment Tool with Weight age	Assessment Tool	Year	Level – 1 (Poorly Attained)	Level – 2 (Moderately Attained)	Level – 3 (Highly Attained)
Continuous Internal Evaluation (CIE) – 40% End Semester Examination (ESE) – 60%	**Internal Evaluation**	1st	40% of the students scoring more than 45% Marks	50% of the students scoring more than 45% Marks	60% of the students scoring more than 45% Marks
		2nd	50% of the students scoring more than 45% Marks	60% of the students scoring more than 45% Marks	70% of the students scoring more than 45% Marks
		3rd	60% of the students scoring more than 45% Marks	70% of the students scoring more than 45% Marks	80% of the students scoring more than 45% Marks
		4th	70% of the students scoring more than 45% Marks	80% of the students scoring more than 45% Marks	90% of the students scoring more than 45% Marks

8.3.3 Assessment Tool for CIE:

Illustration for a course at 2nd year level:

CO	CT – 1 (15)	CT – 2 (15)	CA (10)
CO1	7.5	0	2
CO2	7.5	0	2
CO3	0	5	2
CO4	0	5	2
CO5	0	5	2

Total Marks for CIE: 40

CT – 1: Class Test – 1; CT – 2: Class Test – 2; CA: Class Assessment

Class Average in CIE:

CO	CT – 1 15 Class Avg	CT – 2 15 Class Avg	CA 10 Class Avg	CIE Class Average % age
CO1	5/7.5	0	1.5/2	6.5/9.5 = 68
CO2	6/7.5	0	2/2	8/9.5 = 84
CO3	0	4/5	1.5/2	5.5 / 7 = 79
CO4	0	4.5/5	2/2	6.5 / 7 = 93
CO5	0	3/5	1.8/2	4.8 /7 = 69

Class Average in ESE:

CO	ESE Class Average % age
CO1	63
CO2	61
CO3	71
CO4	56
CO5	67

8.3.4 CO Direct Attainment in a course = 0.4 * Attainment of CO as a percentage ofCIE + 0.6 * Class Average Marks Percentage in ESE

CO	CIE Class Avg (% age)	ESE Class Avg (% age)	Direct CO Attainment = 0.4 x CIE + 0.6 x ESE Class Avg(% age)
CO1	68	63	65
CO2	84	61	70
CO3	79	71	74
CO4	93	56	71
CO5	69	67	68

8.3.5 Calculation of Total CO Attainment in BEE1X01 = 0.9 x Direct CO Attainment + 0.1 x Indirect CO Attainment

CO	Direct CO Attainment (% age)	Indirect CO Attainment (Exit Survey) (% age)	Total CO Attainment = 0.9 x Direct CO Attainment + 0.1 x Indirect Attainment (% age Rounded)
CO1	65	79	66
CO2	70	84	71
CO3	74	87	75
CO4	71	77	72
CO5	68	81	69

8.3.6 CO Attainment Gap:

CO	CO (Target) % age A	CO (Attainment) % age B	Total CO Attainment (Target - Attainment) Gap % age
CO1	70	66	4
CO2	70	71	-1
CO3	70	75	-5
CO4	70	72	-2
CO5	70	69	1

Gap > 0 : Target not attained. Improvement must be planned to increase attainment next time.

Gap ≤ 0 : Target attained or exceeded. Attained target may be enhanced next time.

8.3.7 Closure of Quality Loop:

CO	CO (Target) %age	CO (Attainment Gap) % age	Action Plan to bridge the gap	Modification of target where achieved
CO1	70	4	Action Plan needed	
CO2	70	-1	-	Increase the target to 75%
CO3	70	-5	-	Increase the target to 75%
CO4	70	-2	-	Increase the target to 75%
CO5	70	1	Action Plan needed	

Action Plans for Improving the CO Attainment:

- Plans for action should be as specific as well as feasible.
- Indicate whether any more resources (physical or learning) are required to carry out the improvement plans.
- Indicate whether or not any changes to the Lesson Plan are necessary.
- Avoid using phrases like "motivate the students" and "work harder."
- Have the action plans reviewed by peers if at all practicable.

8.3.8 Increasing CO Attainment Levels:

The CO attainment targets, which are quantified into levels, are raised by raising the targets connected with them with the various levels.

CO	Original CO (Target) % age	Increased CO (Target) % age
Level 3	Class Average is > 70	Class Average is > 75
Level 2	60 < Class Average ≤ 70	65 < Class Average ≤ 75
Level 1	Class Average ≤ 60	Class Average ≤ 65

Chapter 9

Attainment of Program Outcomes and Program Specific Outcomes

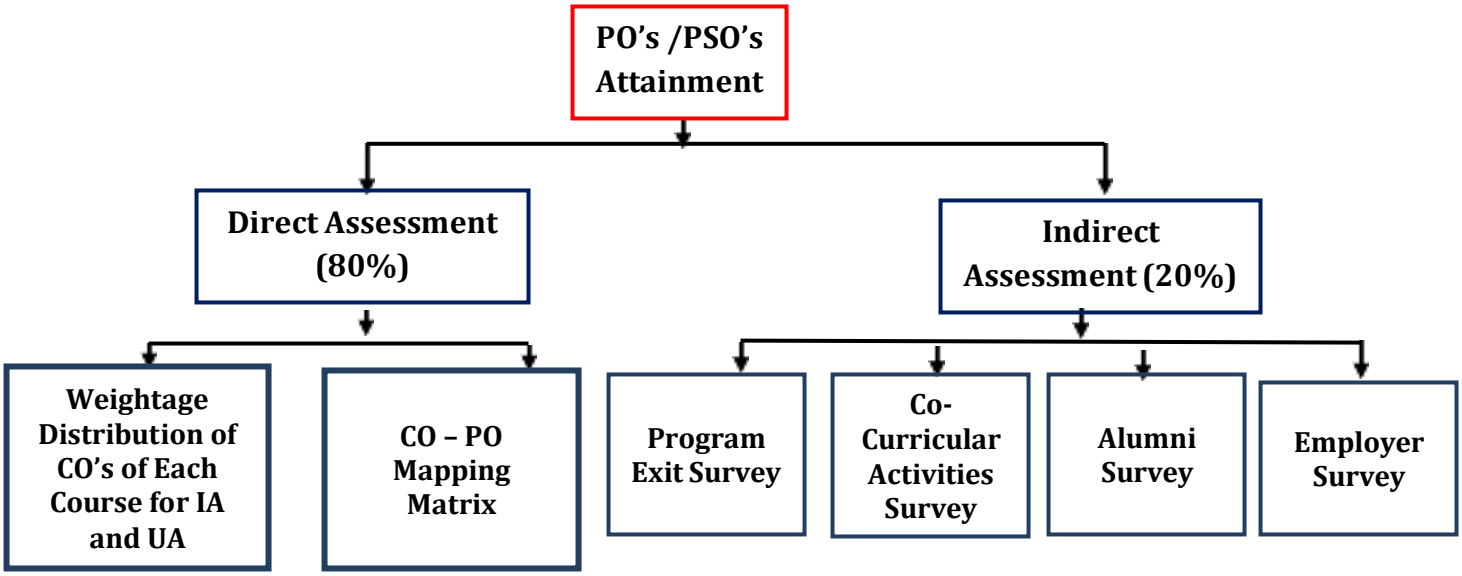
9.1 Assessment tools and processes used for measuring the attainment of each of the Program Outcomes and Program Specific Outcomes

I. Assessment Tools:

Assessment Tools for Measuring the Attainment of Each Program Outcomes (PO's) and Program Specific Outcomes (PSO's) are classified in two categories:

a) Direct Assessment Tools

b) Indirect Assessment Tools



Total Attainment of PO's and PSO's is calculated by considering 80% of Direct Assessment and 20% of Indirect Assessment.

Direct Assessment Tools:

1. Weightage distribution of course outcome of each course for internal and External Exam
2. CO-PO Mapping Matrix

Indirect Assessment Tools:

1. Program Exit Survey
2. Co-Curricular Activities Survey
3. Alumni Survey
4. Employer Survey

II. Process for measuring the attainment of each of the Program Outcomes and Program Specific Outcomes:

A. Direct Attainment:

The direct attainment of Program Outcomes and Program Specific Outcomes is the collection of all the course attainments with the attainment process as described below:

Step 1: CO-PO mapping tables, for all the courses are collected from the respective course coordinators.

CO- PO Mapping of Course: BEELE701T (Control System – II) is as shown below:

BEELE701T	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BEELE701.1	3	2	-	3	-	-	-	-	-	-	-	1	2	2	-
BEELE701.2	3	2	-	1	-	-	-	-	-	-	-	2	3	2	1
BEELE701.3	3	2	-	2	-	-	-	-	-	-	-	2	2	2	1
BEELE701.4	3	2	-	2	-	-	-	-	-	-	-	1	3	2	-
BEELE701.5	3	1	-	3	-	-	-	-	-	-	-	1	2	2	-
BEELE701.6	3	1	-	2	-	-	-	-	-	-	-	1	2	1	1
Average	3	2	-	2								1	2	2	1

Step 2: Average Course Attainment values for all the courses are collected from the respective course coordinators.

Total Direct CO Attainment of Course **BEELE701T (Control System – II)**

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Total Direct CO Attainment	1.80	1.80	1.80	1.40	1.40	1.40
Total Indirect CO Attainment	3.00	3.00	3.00	3.00	2.00	2.00
Total CO Attainment for Theory Course (80% of Total Direct CO Attainment + 20% of Total Indirect CO Attainment	**2.04**	**2.04**	**2.04**	**1.72**	**1.52**	**1.52**

Step 3: From the above values, Course-PO attainment values are calculated using

$$\text{Course\_PO attainment} = \frac{(Course\ PO\ Mapping) * (Course\ Attainment)}{3}$$

Step 4: The average of all these attainments with respect to individual POs and PSO's is calculated. This gives the direct PO and PSO's Attainment.

CO – PO Attainment of Course BEELE701T (Control System – II)

BEELE701T	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
BEELE701.1	2.04	1.36	0.00	2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68
BEELE701.2	2.04	1.36	0.00	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36
BEELE701.3	2.04	1.36	0.00	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36
BEELE701.4	1.72	1.15	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
BEELE701.5	1.52	0.51	0.00	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
BEELE701.6	1.52	0.51	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
Average	**1.81**	**1.04**	**0.00**	**1.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.83**

CO – PSO Attainment of Course BEELE701T (Control System – II)

BEELE701T	PSO1	PSO2	PSO3
BEELE701.1	1.36	1.36	0.00
BEELE701.2	2.04	1.36	0.68
BEELE701.3	1.36	1.36	0.68
BEELE701.4	1.72	1.15	0.00
BEELE701.5	1.01	1.01	0.00
BEELE701.6	1.01	0.51	0.51
Average	**1.42**	**1.12**	**0.62**

B. Indirect Attainment:

Following Surveys are conducted on Program Outcomes and Program Specific Outcomes from the respective stakeholders of the process;

1. Program Exit Survey
2. Co-Curricular Activities Assessment Survey
3. Alumni Survey
4. Employer Survey

Opinions of these stakeholders are collected in a grading scale of 5 (Substantial or High) to 1 (Slight or Low). Average of all the feedbacks given by the stake holders are considered to be indirect attainment.

Indirect Assessment	
Exit survey	To gather the satisfaction level offered by the program.
Co-Curricular Activities Assessment Survey	Co-Curricular Activities Assessment Survey gathers statistics of students and faculty participation in various activities viz. ISTE, IEI and CSI student chapters, NSS, workshops, seminars, conferences, paper presentations, internships, industrial visits and project exhibitions attended and organized.
Alumni survey	Gathers the information about the success of the imparted program from the graduates
Employer survey	Gathers the feedback about graduate's industry relevant skills.

9.2 Sample Exit Survey

S. No	Program Outcomes(POs)	POs	Excellent (3)	Very Good (2)	Satisfactory (1)
1.	Have you gained knowledge of mathematics, science, and engineering to solve Engineering problems and modeling?	**PO1**			
2.	Are you able to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software Components?	**PO2**			
3.	Are you able to apply engineering knowledge to design a complex electronic system or process to meet desired specifications and needs?	**PO3**			
4.	Are you able to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions?	**PO4**			
5.	Can you use the techniques, skills and modern engineering tools necessary for engineering practice?	**PO5**			
6.	Are you able to show the understanding of professional, health, safety, legal, cultural and social responsibilities?	**PO6**			
7.	Are you able to understand the impact of engineering solutions in a global, economic and environmental and demonstrate the knowledge needed for sustainable development?	**PO7**			
8.	Are you able to apply ethical principles, responsibility and norms of the engineering practice?	**PO8**			
9.	Can you function on multi-disciplinary Teams?	**PO9**			
10.	Are you able to communicate and presentEffectively?	**PO10**			
11.	Are you able to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments?	**PO11**			
12.	Do you have the ability to engage in, to resolve contemporary issues and lifelong learning?	**PO12**			
13.	Are you able to formulate the solutions to Electrical and Electronics Engineering problems using the basic concepts?	**PSO1**			
14.	Can you develop the process to interpret networks parameters in power system operation and control with their protection and driving mechanisms?	**PSO2**			
15.	Can you apply project based learning to conduct experiments with Electrical Machines, Power Electronics to develop energy efficient systems?	**PSO3**			

9.3 Sample Co-curricular Activities Assessment Survey

(To be collected from the beneficiaries of the activity after the completion of the activity)

S. No	Program Outcomes(POs)	POs	Excellent (3)	Very Good (2)	Satisfactory (1)
1.	Have you gained knowledge of mathematics, science, and engineering to solve Engineering problems and modeling?	**PO1**			
2.	Are you able to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software Components?	**PO2**			
3.	Are you able to apply engineering knowledge to design a complex electronic system or process to meet desired specifications and needs?	**PO3**			
4.	Are you able to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions?	**PO4**			
5.	Can you use the techniques, skills and modern engineering tools necessary for engineering practice?	**PO5**			
6.	Are you able to show the understanding of professional, health, safety, legal, cultural and social responsibilities?	**PO6**			
7.	Are you able to understand the impact of engineering solutions in a global, economic and environmental and demonstrate the knowledge needed for sustainable development?	**PO7**			
8.	Are you able to apply ethical principles, responsibility and norms of the engineering practice?	**PO8**			
9.	Can you function on multi-disciplinary Teams?	**PO9**			
10.	Are you able to communicate and present Effectively?	**PO10**			
11.	Are you able to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments?	**PO11**			
12.	Do you have the ability to engage in, to resolve contemporary issues and lifelong learning?	**PO12**			
13.	Are you able to formulate the solutions to Electrical and Electronics Engineering problems using the basic concepts?	**PSO1**			
14.	Can you develop the process to interpret networks parameters in power system operation and control with their protection and driving mechanisms?	**PSO2**			
15.	Can you apply project based learning to conduct experiments with Electrical Machines, Power Electronics to develop energy efficient systems?	**PSO3**			

9.4 Sample Alumni Survey

S. No	Program Outcomes(POs)	POs	Excellent (3)	Very Good (2)	Satisfactory (1)
1.	Have you gained knowledge of mathematics, science, and engineering to solve Engineering problems and modeling?	**PO1**			
2.	Are you able to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software Components?	**PO2**			
3.	Are you able to apply engineering knowledge to design a complex electronic system or process to meet desired specifications and needs?	**PO3**			
4.	Are you able to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions?	**PO4**			
5.	Can you use the techniques, skills and modern engineering tools necessary for engineering practice?	**PO5**			
6.	Are you able to show the understanding of professional, health, safety, legal, cultural and social responsibilities?	**PO6**			
7.	Are you able to understand the impact of engineering solutions in a global, economic and environmental and demonstrate the knowledge needed for sustainable development?	**PO7**			
8.	Are you able to apply ethical principles, responsibility and norms of the engineering practice?	**PO8**			
9.	Can you function on multi-disciplinary Teams?	**PO9**			
10.	Are you able to communicate and presentEffectively?	**PO10**			
11.	Are you able to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments?	**PO11**			
12.	Do you have the ability to engage in, to resolve contemporary issues and lifelong learning?	**PO12**			
13.	Are you able to formulate the solutions to Electrical and Electronics Engineering problems using the basic concepts?	**PSO1**			
14.	Can you develop the process to interpret networks parameters in power system operation and control with their protection and driving mechanisms?	**PSO2**			
15.	Can you apply project based learning to conduct experiments with Electrical Machines, Power Electronics to develop energy efficient systems?	**PSO3**			

9.5 Sample Employer Survey

S. No	Program Outcomes(POs)	POs	Excellent (3)	Very Good (2)	Satisfactory (1)
1.	Have you found knowledge of mathematics, science, and engineering to solve Engineering problems in our graduates?	**PO1**			
2.	Are our graduates able to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software Components?	**PO2**			
3.	Are our graduates able to apply engineering knowledge to design a complex electronic system or process to meet desired specifications and needs?	**PO3**			
4.	Are our graduates able to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions?	**PO4**			
5.	Are our graduates able to use the techniques, skills and modern engineering tools necessary for engineering practice?	**PO5**			
6.	Are our graduates able to show the understanding of professional, health, safety, legal, cultural and social responsibilities?	**PO6**			
7.	Are our graduates able to understand the impact of engineering solutions in a global, economic and environmental and demonstrate the knowledge needed for sustainable development?	**PO7**			
8.	Are our graduates able to apply ethical principles, responsibility and norms of the engineering practice?	**PO8**			
9.	Are our graduates able to function on multi-disciplinary teams?	**PO9**			
10	Are our graduates able to communicate and present effectively?	**PO10**			
11.	Are our graduates able to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments?	**PO11**			
12.	Are our graduates have the ability to engage in, to resolve contemporary issues and lifelong learning?	**PO12**			
13.	Are our graduates able to formulate the solutions to Electrical and Electronics Engineering problems using the basic concepts?	**PSO1**			
14.	Can our graduates develop the process to interpret networks parameters in power system operation and control with their protection and driving mechanisms?	**PSO2**			
15.	Can our graduates apply project based learning to conduct experiments with Electrical Machines, Power Electronics to develop energy efficient systems?	**PSO3**			

Chapter 10

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

10.1. PO/PSO Attainment Target for the course

- PO's and PSO's Attainment level is set based on previous three years' average performance levels in the university examination in that course.
- CO-PO-PSO Mapping is taken as reference for the setting of target for a batch.

PO/PSO Attainment Target for the course for with respect to PO/PSO is calculated as below;

Target

$$= \frac{(\textbf{Avg of last 3 yrs Univ. Result of the course x Mapping Strength of the Course with the PO})}{\textbf{100}}$$

Example:

Sem	Course Code	Course Name	PO1		
			Mapping Strength	Avg. of 3 yrs. Univ. Result	Target
III	BEELE302T	Non-Conventional Energy Sources	3	60	$\frac{(3\ X\ 60)}{100} = 1.8$ **Round Up** $= 2$
IV	BEELE401T	Applied Mathematics – IV	2	66	$\frac{(2\ X\ 66)}{100} = 1.3$ **Round Down** $= 1$

Similarly the Level is set for all the courses of all the semesters in the Program for all the PO's and PSO's.

10.2. Target Level for sample two courses for all the PO's and PSO's are as given below

PO/PSO	BEELE302T	BEELE401T
PO-1	2	1
PO-2	1	1
PO-3	1	-
PO-4	1	2
PO-5	-	-
PO-6	-	-
PO-7	1	-
PO-8	-	-
PO-9	-	-

PO-10	-	-
PO-11	-	-
PO-12	2	2
PSO – 1	1	1
PSO – 2	-	-
PSO – 3	1	-

The process is carried out for all the courses for the batch and the target level is set by the above process. Once the target level for all courses with respect to all PO's and PSO's are obtained, the average of the same is calculated for the complete batch for all the 12 PO's and 3 PSO's.

10.3 Target Level for a batch obtained from the above process is as given below

PO/PSO	Target Level Set for the Batch
PO-1	2.11
PO-2	1.68
PO-3	1.55
PO-4	1.94
PO-5	1.43
PO-6	2.75
PO-7	2.02
PO-8	2.29
PO-9	2.10
PO-10	2.14
PO-11	2.10
PO-12	2.24
PSO – 1	2.12
PSO – 2	1.75
PSO – 3	1.33

10.4 Target Level illustration for PO-1 for all the courses in a batch

Sem	Course Code	Course Name	University Result				PO1		
			W-14	W-15	W-16	Average	Mapping Strength	Round up Avg.	Target
III Semester	BEELE301T	Applied Mathematics-III	46.96	45.1	45.26	45.7733	2	46	1
	BEELE302T	Non Conventional Energy Sources	48.28	69.89	63.29	60.4867	3	60	2
	BEELE303T	Electrical Measurement & Instrumentation	39.01	46.08	43.18	42.7567	2	43	1
	BEELE303P	Electrical Measurement & Instrumentation Lab	97.33	96.01	90.28	94.54	2	95	2
	BEELE304T	Network Analysis	28.57	51.4	39.01	39.66	3	40	1
	BEELE304P	Network Analysis Lab	96.05	96.01	83.31	91.79	2	92	2
	BEELE305T	Electronic Devices & Circuits	29.17	55.14	26.04	36.7833	3	37	1
	BEELE305P	Electronic Devices & Circuits Lab	97.33	97.3	91.55	95.3933	2	95	2
			S-15	S-16	S-17	Average	-	-	-
IV Semester	BEELE401T	Applied Mathematics-IV	68.89	68.89	60.53	66.1033	2	66	1
	BEELE402T	Elements of Electromagnetics	55.88	55.88	43.75	51.8367	2	52	1
	BEELE403T	Digital and Linear Electronics Circuits	48.51	48.51	53.09	50.0367	2	50	1
	BEELE403P	Digital and Linear Electronics Circuits Lab	98.63	98.63	90.91	96.0567	2	96	2
	BEELE404T	Electrical Machine-I	51.49	51.49	37.04	46.6733	2	47	1
	BEELE404P	Electrical Machine-I Lab	98.63	98.63	93.94	97.0667	2	97	2
	BEELE405T	Computer Programming	61.22	61.22	43.9	55.4467	1	55	1
	BEELE405P	Computer Programming Lab	98.63	98.63	93.94	97.0667	1	97	1
	BEELE406T	Environmental Studies	100	100	100	100	-	-	-
			W-15	W-16	W-17	Average	-	-	-
V Semester	BEELE501T	Electrical Power System-I	74.58	69.86	76.56	73.6667	3	74	2
	BEELE502T	Utilization of Electric Energy	87.93	82.61	82.46	84.3333	2	84	2
	BEELE503T	Electrical Machine Design	76.67	81.08	71.21	76.32	3	76	2
	BEELE504T	Microprocessor & Interfacing	85.25	79.17	80.35	81.59	2	82	2
	BEELE504P	Microprocessor & Interfacing Lab	98.25	100	100	99.4167	2	99	2
	BEELE505T	Electrical Machine-II	72.13	70.27	65.57	69.3233	3	69	2
	BEELE505P	Electrical Machine-II Lab	98.25	100	100	99.4167	3	99	3
	BEELE506P	Electrical Drawing & Simulation	98.25	98.55	98.25	98.35	3	98	3
	BEELE507P	Electrical Engineering Workshop	98.25	100	100	99.4167	3	99	3
			S-16	S-17	S-18	Average	-	-	-
VI Semester	BEELE601T	Power Station Practice	82.46	84.51	88.14	85.0367	2	85	2
	BEELE602T	Engineering Economics & Industrial Management	73.68	78.08	89.47	80.41	-	-	-
	BEELE603T	Electrical Drives & Their Control	84.48	84.72	77.78	82.3267	3	82	2
	BEELE604T	Power Electronics	61.02	58.54	72.06	63.8733	3	64	2
	BEELE604P	Power Electronics Lab	100	98.55	100	99.5167	3	100	3
	BEELE605T	Control System-I	66.1	75.32	81.82	74.4133	3	74	2
	BEELE605P	Control System-I Lab	100	98.55	100	99.5167	3	100	3
	BEELE606P	Industrial Visits & Report Writing	100	100	100	100	3	100	3
	BEELE607T	Functional English	91.23	85.71	91.8	89.58	-	-	-
			W-16	W-17	W-18	Average	-	-	-
VII Semester	BEELE701T	Control Sytsem -II	53.57	78.57	60.87	64.3367	3	64	2
	BEELE702T	Electrical Power System-II	80	68.18	73.13	73.77	3	74	2
	BEELE703T	Elective-I Energy Management & Audit	100	90.2	91.11	93.77	2	94	2
	BEELE704T	High Voltage Engineering	58.93	71.01	77.27	69.07	3	69	2
	BEELE704P	High Voltage Engineering Lab	100	100	100	100	3	100	3
	BEELE705T	Electrical Installation Design	74.55	79.41	86.15	80.0367	3	80	2
	BEELE705P	Electrical Installation Design Lab	100	100	100	100	3	100	3
	BEELE706P	Project Seminar	100	100	100	100	3	100	3
			S-17	S-18	S-19	Average	-	-	-
VIII Semester	BEELE801T	Elective-II Electrical Distribution System	100	94.92	93.33	96.0833	3	96	3
	BEELE802T	Elective-III EHV AC and HVDC Transmission	92.86	98.48	96.77	96.0367	3	96	3
	BEELE803T	Switchgear & Protection	94.64	90.77	93.65	93.02	3	93	3
	BEELE803P	Switchgear & Protection Lab	100	100	100	100	3	100	3
	BEELE804T	Computer Application in Power System	91.07	98.85	82.81	90.91	3	91	3
	BEELE804P	Computer Application in Power System Lab	100	100	100	100	3	100	3
	BEELE805P	Project	100	100	100	100	3	100	3
		Target PO & PSO					2.56	81.09	2.11

Chapter 11
Overall PO and PSO Attainment

The evaluation of each POs and PSOs are shown in tables below

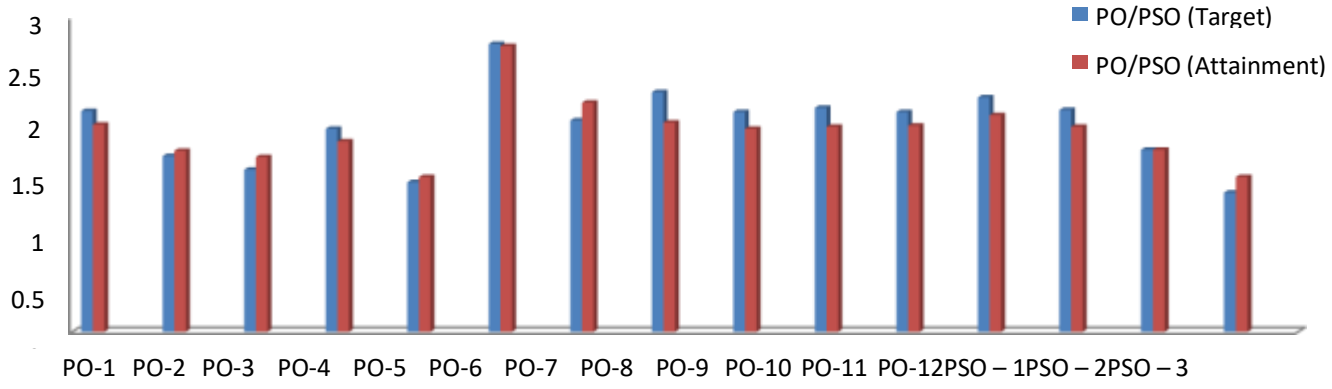
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BESI-1T	2.36	1.57	-	-	-	-	-	-	-	-	-	0.79	-	-	-
BSEI-2T	2.31	2.10	-	-	-	-	-	-	-	-	-	2.31	-	-	-
BSEI-3T	2.04	1.36	0.17	0.68	-	-	-	-	-	-	-	1.36	-	-	-
BSEI-4T	1.97	1.57	1.00	-	-	-	-	-	-	-	-	1.76	-	-	-
BSEI-5T	2.42	1.81	0.19	0.60	-	-	-	-	-	-	-	2.03	-	-	-
BSEI-6T	1.99	1.33	0.68	0.66	-	-	-	-	-	-	-	1.31	-	-	-
BSEI-2P	2.52	1.68	-	-	-	-	-	1.68	2.52	2.52	-	2.52	-	-	-
BSEI-3P	1.68	1.68	-	-	-	-	0.84	-	-	-	-	0.84	-	-	-
BSEI-4P	2.47	1.65	0.82	-	-	-	-	-	-	-	-	2.47	-	-	-
BSEI-6P	2.47	1.65	0.82	0.82	0.82	-	-	-	-	0.82	0.82	2.47	-	-	-
BSEI-7T	-	-	-	-	-	-	-	-	1.68	1.68	-	2.52	-	-	-
BSEII-1T	2.20	1.47	-	-	-	-	-	-	-	-	-	0.73	-	-	-
BSEII-2T	2.80	2.62	-	-	-	-	-	-	-	-	-	2.80	-	-	-
BSEII-3T	2.10	1.68	0.21	-	-	-	-	-	-	-	-	1.68	-	-	-
BSEII-4T	1.94	1.28	0.15	0.65	-	-	-	-	-	-	-	1.29	-	-	-
BSEII-5T	1.22	0.88	0.34	-	-	-	-	-	-	-	-	1.22	-	-	-
BSEII-6T	2.47	1.65	0.82	0.82	0.82	-	-	-	-	0.82	0.82	2.47	-	-	-
BSEII-2P	2.52	1.68	-	-	-	-	-	2.52	2.52	2.52	-	-	-	-	-
BSEII-3P	1.95	1.95	-	-	-	-	0.97	-	-	-	-	0.97	-	-	-
BSEII-4P	1.99	0.66	0.66	0.66	0.66	-	-	-	-	-	-	1.99	-	-	-
BSEII-7T	2.52	1.68	0.84	0.84	-	-	-	-	-	-	-	1.68	-	-	-
BEELE301T	0.71	0.57	-	1.05	-	-	-	-	-	-	-	1.61	1.07	-	-
BEELE302T	1.85	1.11	0.32	1.62	-	-	-	-	-	-	-	2.09	0.70	-	0.70
BEELE303T	1.25	0.61	-	0.70	-	-	-	-	-	-	-	1.61	1.07	-	-
BEELE303P	1.60	0.80	-	0.80	-	-	-	2.40	1.60	1.60	0.80	2.40	2.40	1.60	-
BEELE304T	1.31	0.69	-	1.10	-	-	-	-	-	-	-	1.61	1.61	-	-
BEELE304P	1.28	0.64	-	0.64	-	-	-	1.92	1.28	1.28	0.64	1.92	1.92	0.64	-
BEELE305T	1.41	0.71	-	1.11	-	-	-	-	-	-	-	1.61	1.07	-	-
BEELE305P	1.28	0.64	-	-	-	-	-	1.92	1.28	1.28	0.64	1.92	1.92	0.64	-
BEELE401T	0.76	0.62	-	1.32	-	-	-	-	-	-	-	1.61	1.07	-	-
BEELE402T	1.21	0.68	-	0.65	-	-	-	-	-	-	-	1.61	1.61	-	-
BEELE403T	0.95	0.54	-	0.52	-	-	-	-	-	-	-	1.61	0.54	-	-
BEELE403P	1.28	0.64	-	-	-	-	-	-	-	-	-	1.92	1.92	0.64	-
BEELE404T	1.07	0.74	-	0.78	-	-	-	-	-	-	-	1.61	1.61	1.07	-
BEELE404P	1.60	1.60	-	0.80	-	-	-	2.40	1.60	1.60	0.80	2.40	2.40	0.80	0.80

BEELE405T	0.54	0.54	-	1.12	0.27	-	-	-	-	-	-	1.61	-	-	-
BEELE405P	0.64	0.64	-	-	-	-	-	1.92	1.28	1.28	0.64	1.92	-	-	-
BEELE501T	2.01	1.89	0.65	1.45	0.84	-	-	-	-	-	-	2.01	1.90	1.46	0.65
BEELE502T	1.11	0.75	1.09	0.92	0.67	-	-	-	-	-	-	1.75	1.32	1.25	0.68
BEELE503T	1.88	1.88	-	1.88	0.63	-	-	-	-	-	-	1.25	1.38	1.48	0.91
BEELE504T	1.04	0.52	-	1.04	1.04	-	-	-	-	-	-	1.57	1.04	-	-
BEELE504P	1.60	0.80	-	1.60	1.60	-	-	2.40	1.60	1.60	0.80	2.40	2.40	-	-
BEELE505T	1.78	1.78	-	1.78	0.59	-	-	-	-	-	-	1.19	1.31	1.39	0.86
BEELE505P	2.40	1.60	-	2.40	0.80	-	-	2.40	1.60	1.60	2.40	2.40	2.40	1.60	1.60
BEELE506P	2.44	2.44	0.81	2.44	1.63	-	-	0.81	1.63	1.63	2.44	2.44	2.44	1.63	0.81
BEELE507P	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44
BEELE601T	1.16	1.16	0.99	0.50	0.49	-	-	-	-	-	-	1.48	1.13	1.05	0.57
BEELE602T	1.14	1.14	0.97	0.49	0.49	-	0.49	0.49	-	-	-	1.46	1.16	1.02	0.56
BEELE603T	1.44	1.34	0.47	0.96	0.82	-	-	-	-	-	-	1.44	1.08	1.13	0.69
BEELE604T	1.75	1.75	-	1.75	0.58	-	-	-	-	-	-	1.75	1.48	1.28	0.97
BEELE604P	1.92	1.92	-	1.92	0.64	-	-	1.28	1.28	1.28	1.92	1.92	1.92	1.28	1.28
BEELE605T	1.65	1.65	-	1.65	0.55	-	-	-	-	-	-	1.65	1.30	1.02	0.57
BEELE605P	1.92	1.92	-	1.92	0.64	-	-	1.28	1.28	1.28	1.92	1.92	1.92	1.28	1.28
BEELE606P	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96
BEELE607T	-	-	-	-	-	-	-	1.45	1.08	2.15	2.15	2.15	-	-	-
BEELE701T	1.81	1.04	-	1.29	-	-	-	-	-	-	-	0.83	1.42	1.12	0.62
BEELE702T	2.29	1.79	1.25	1.50	0.67	-	0.67	0.67	-	-	-	1.81	2.18	1.67	0.72
BEELE703T	1.61	1.94	1.14	2.17	1.23	-	2.10	1.40	-	-	-	2.17	2.05	1.30	0.96
BEELE704T	2.42	1.48	0.84	-	-	-	-	-	1.59	0.80	0.80	1.08	1.63	1.08	0.77
BEELE704P	2.40	1.60	-	2.40	0.80	-	-	2.40	1.60	1.60	-	0.80	2.40	0.80	-
BEELE705T	2.42	1.88	1.29	1.74	0.81	-	-	-	-	-	-	2.14	2.03	2.01	1.00
BEELE705P	2.40	2.40	0.80	2.40	1.60	-	-	1.60	1.60	1.60	2.40	2.40	2.40	1.60	1.60
BEELE706P	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
BEELE801T	1.81	1.81	-	1.01	-	-	-	-	-	-	-	1.21	1.62	1.39	0.69
BEELE802T	1.81	1.81	-	1.10	-	-	-	-	-	-	-	1.81	1.34	1.41	0.90
BEELE803T	2.29	1.64	-	1.51	-	-	-	-	-	-	-	1.65	1.79	2.18	0.91
BEELE803P	2.40	1.60	-	2.40	0.80	-	-	1.60	1.60	1.60	-	2.40	2.40	2.40	0.80
BEELE804T	1.81	1.21	-	1.81	-	-	-	-	-	-	-	0.60	1.72	1.21	0.62
BEELE804P	2.40	2.40	-	2.40	1.60	-	-	0.80	1.60	1.60	2.40	2.40	2.40	1.60	0.80
BEELE805P	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
Avg. of Direct Attainment	1.72	1.41	1.34	1.53	1.13	2.71	2.01	1.82	1.72	1.73	1.75	1.84	1.77	1.47	1.10
80% of direct attainment	1.38	1.13	1.07	1.23	0.91	2.17	1.61	1.45	1.37	1.38	1.40	1.47	1.41	1.18	0.88
Avg. of Indirect Attainment	3.00	3.00	3.00	2.95	2.85	2.80	2.90	2.75	2.85	2.90	2.85	3.00	2.75	2.80	3.00
20% of Indirect attainment	0.60	0.60	0.60	0.59	0.57	0.56	0.58	0.55	0.57	0.58	0.57	0.60	0.55	0.56	0.60
PO and PSO Attainment	**1.98**	**1.73**	**1.67**	**1.82**	**1.48**	**2.73**	**2.19**	**2.00**	**1.94**	**1.96**	**1.97**	**2.07**	**1.96**	**1.74**	**1.48**

PO/ PSO	PO/PSO (Target)	PO/PSO (Attainment)	(Target - Attainment) Gap	Trend of Attainment
PO-1	2.11	1.98	0.13	↓
PO-2	1.68	1.73	-0.05	↑
PO-3	1.55	1.67	-0.12	↑
PO-4	1.94	1.82	0.09	↓
PO-5	1.43	1.48	-0.05	↑
PO-6	2.75	2.73	0.02	↓
PO-7	2.02	2.19	-0.17	↑
PO-8	2.29	2	0.29	↓
PO-9	2.10	1.94	0.16	↓
PO-10	2.14	1.96	0.18	↓
PO-11	2.10	1.97	0.13	↓
PO-12	2.24	2.07	0.17	↓
PSO – 1	2.12	1.96	0.16	↓
PSO – 2	1.74	1.74	0.00	=
PSO – 3	1.33	1.48	-0.15	↓

Gap > 0 : Target not attained. Improvement must be planned to increase attainment next time.

Gap ≤ 0 : Target attained or exceeded. Attained target may be enhanced next time.



Chapter 12
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