HITEC UNIVERSITY OUTCOME BASED EDUCATION (OBE) FRAMEWORK --- GUIDELINES

HITEC University Taxila

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1. OBE Framework Guidelines --- AIM

In compliance with the requirements and guidelines of the Pakistan Engineering Council (PEC) for Outcome-Based Education (OBE), HITEC University (HTU) has undertaken a structured initiative to institutionalize OBE practices across all engineering academic departments. Recognizing the need for uniformity, coherence, and standardization in implementation, the University has developed the *OBE Framework Guidelines* as a reference document. A schematic representation of the OBE implementation framework is presented in Figure 1, providing an overview of the key processes and linkages at a glance.

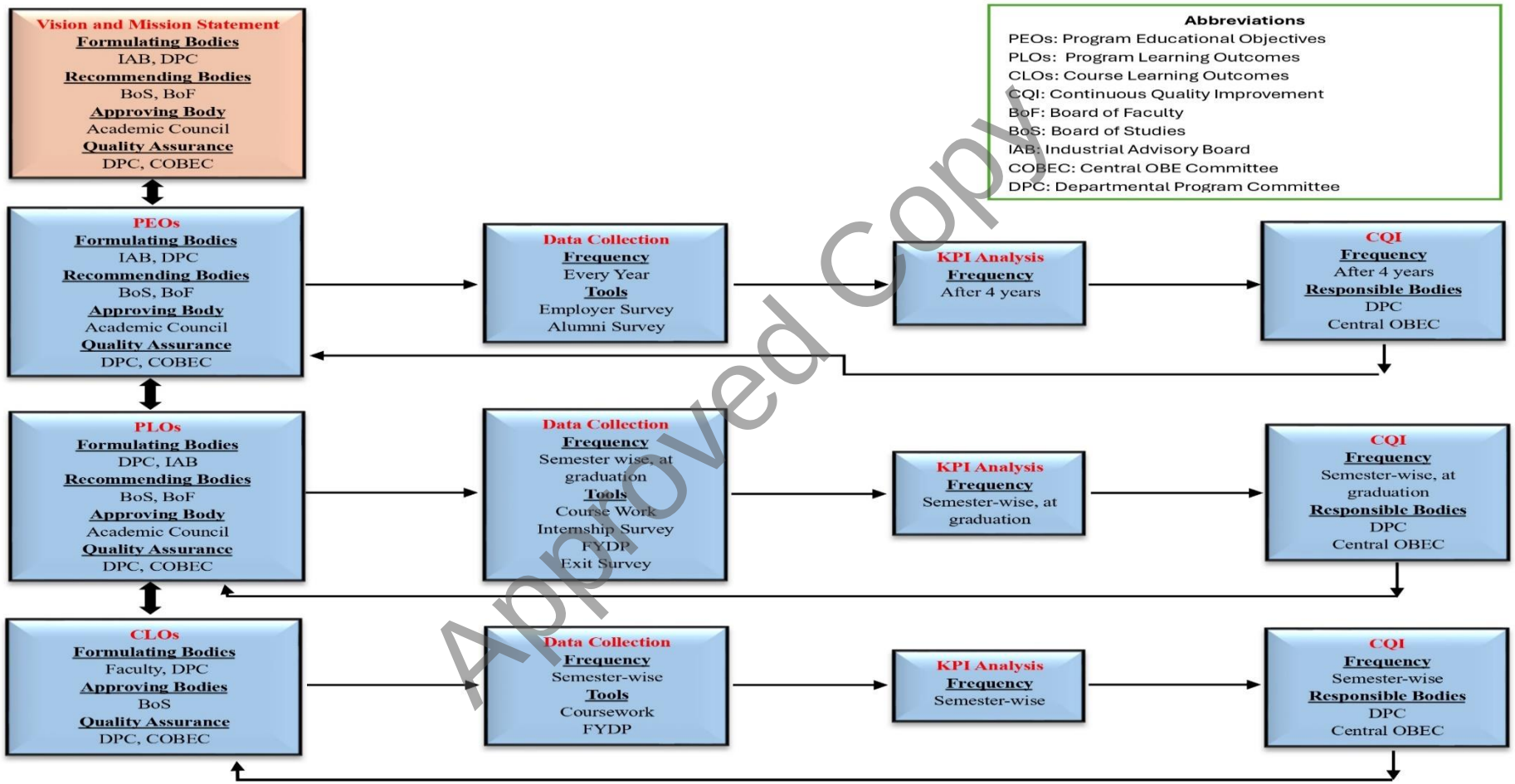
The development of this framework was led by the Directorate of Quality Assurance and Collaboration and subsequently circulated to all departments for detailed review and deliberation. The framework was thoroughly examined by the respective Boards of Studies of the departments, and their inputs and recommendations were consolidated and presented to the Board of Faculty of Engineering & Technology. Upon comprehensive deliberation, the Board of Faculty endorsed the document and recommended it for approval by the Academic Council. The Academic Council duly approved the *OBE Framework Guidelines* and directed its implementation across the University.

This document provides a structured approach for the formulation and implementation of key OBE components, including Program Educational Objectives (PEOs), Program Learning Outcomes (PLOs), and Course Learning Outcomes (CLOs), along with their systematic mapping and alignment. It further establishes standardized mechanisms for assessment, evaluation, and Continuous Quality Improvement (CQI), supported by defined Key Performance Indicators (KPIs) and evidence-based processes.

The *OBE Framework Guidelines* serve as a standardized framework and guiding template for all departments to develop and refine their respective OBE Manuals. It is intended to ensure alignment with PEC accreditation requirements, facilitate consistent implementation of outcome-based processes, and strengthen CQI practices to support sustained attainment of PEOs and PLOs.

Approved in 40th Academic Council Meeting held on March 04, 2026

2. OBE Framework Block Diagram



3. Former Vision & Mission HITEC University

F-Vision

HITEC University shall be a premier institution and bastion of academic excellence. It must become a citadel of our ideological moorings, national integration and socio-religious values. HITEC ought to trigger the human mind to think clearly perceiving the environment and issues confronting human beings, seeking intelligent, viable and practical solutions, leading to societal development and the overall betterment of human race. The campus shall provide our progeny the environment for intellectual flourishment, nurturing fertility of thought and creativity. HITEC University faculty will focus on preparing our youth to face the challenges of life with honour, confidence and fortitude through character building and grooming. In HITEC University merit, justice, honesty and adherence to moral and social values must prevail. The University shall provide a pedestal for fulfilment of our youth's aspirations and hopes to live an honourable life as citizens of Pakistan.

F-Mission

HITEC University will be a centre of excellence in teaching, learning and research. We instil and inspire intellectual curiosity, lifelong quest for knowledge and keen urge for social and moral responsibility. The University will establish strong linkages with industry, ensuring innovative research leading to economic prosperity of Pakistan.

4. Revised Vision & Mission

R-Vision

To be a premier institution to achieve academic excellence, innovative solutions in collaboration with industry for sustainable development and socio-economic growth with gender equality.

R-Mission

To impart quality education to the students by equipping with knowledge, research, creativity and entrepreneurial skills to compete in the local and global market. We are committed on building strong linkages with the industry for innovative solutions, contribution to the challenge of socio-economic development and gender equality.

5. HITEC University

HITEC University is a private sector university. In November 2007, classes were commenced in affiliation with the University of Engineering and Technology, Taxila with an intake of 250 students. The University was granted its own charter in November 2009 by the Government of the Punjab. The University is sponsored by Heavy Industries Taxila Education Welfare Trust (HITEWT). The undergraduate programs include BS Electrical Engineering, BS Mechanical Engineering, BS Computer Engineering, BS Civil Engineering, BS Biomedical Engineering, BS Computer Science, BS Software Engineering, BS Islamic Studies, BS Mathematics, BS Accounting and Finance, BS Robotics and Automation, BS in IoT and BBA. Besides these programs, masters and doctoral programs in Electrical Engineering, Mechanical Engineering, Computer Engineering, Computer Science, Mathematics and Islamic Studies are also being offered.

With new technologies and businesses emerging at a faster pace, the gap between the developing and the developed nations of the world continues to widen. HITEC University, right from its inception, has been working to promote human resource development for bridging this gap. By providing undergraduate and graduate level education, HITEC University aims to address the industrial and business needs of the country. Every program strongly focuses on quality education and ensures that the gap between academia and industry is well bridged.

Students at HITEC University get ample opportunities for internships and employment due to close proximity of the University to Heavy Industries Taxila, Pakistan Ordinance Factories, Heavy Mechanical Complex, Pakistan Aeronautical Complex, Kamra, Telephone Industries of Pakistan and FECTO Cement, etc. In addition to its emphasis on quality education, the University also assigns equal importance to character building, extra-curricular and co-curricular activities. We aim to make our students morally, physically and mentally sound individuals and responsible citizens of Pakistan with a strong urge of service to humanity at national and international levels.

6. OBE in HITEC University

From the standpoint of the Faculty of Engineering at HITEC University, the transition to Outcome-Based Education (OBE) represents a defining milestone in our academic evolution. In 2014, the faculty was formally entrusted with the responsibility of shifting from a traditional content-driven approach to a structured, outcomes-focused educational framework. This transformation was guided by the comprehensive standards and directives issued by the Pakistan Engineering Council, which provided the foundation for aligning our programs with international accreditation benchmarks.

At the time, the Faculty of Engineering comprised only two departments: Mechanical Engineering and Electrical Engineering. Recognizing that the success of OBE hinges on faculty preparedness, we undertook extensive capacity-building initiatives. A series of training workshops, seminars, and collaborative sessions—both within the university and through external engagements—were organized to equip the University's academic staff with a thorough understanding of OBE principles, assessment methodologies, and continuous quality improvement processes. Despite the inherent challenges of such a systemic transition, the faculty demonstrated remarkable commitment and adaptability.

Within a year, the faculty successfully embedded the OBE philosophy into our curricula. Courses were comprehensively redesigned, and Course Learning Outcomes (CLOs), carefully aligned with Bloom's Taxonomy, were developed for each course. Initially, the emphasis was placed on engineering disciplines; however, this structured approach was progressively extended to natural sciences and, subsequently, to humanities courses. This ensured a cohesive and institution-wide adoption of outcome-based practices.

The formal implementation of OBE commenced in 2015. A significant achievement followed when the Mechanical and Electrical Engineering programs secured Level II accreditation for the 2K12 and 2K13 batches. Furthermore, the 2K16 cohort became the first to graduate under a fully integrated OBE system, marking a critical validation of our efforts. As the university expanded, newly established departments—including Civil Engineering and Computer Engineering in 2019, and Biomedical Engineering in 2021—adopted the OBE framework from their inception, ensuring consistency and academic rigor across all programs.

Looking ahead, the emphasis remains on developing graduates who are not only technically proficient but also innovative, ethically responsible, and adaptable to the evolving needs of industry and society. Outcome-Based Education at HITEC University is regarded not as a one-time accomplishment but as a continuous process of improvement. Through sustained program evaluation, incorporation of stakeholder feedback, and ongoing refinement of teaching and assessment practices, the Faculty of Engineering continues to strengthen the quality and relevance of its academic offerings. This enduring commitment ensures that the institution remains aligned with global educational standards while contributing meaningfully to the development of future engineering professionals.

7. Accreditation Profile

Profile Summary (Program Specific)

S. No	Intake Batch	Year of Accreditation	Accreditation No of Years
1.	Batch 2007	2011	One Year
2	Batch 2008 Batch 2009	2012	Two Year

Profile with Accreditation Decision (Program Specific)

Intake Batch	Year of Accreditation	Accreditation Decision
Batch 2007	2011	62nd PEC EA &QEC Meeting held on November 14-15, 2011. Letter No. PEC/EA&QEC/HITEC-T/CL-62/2012, dated 14th Feb 2012 **The program accredited for a period of one year.** **Number of graduates Session 2007 = 126**
Batch 2008 **Batch 2009**	2012	63rd PEC EA &QEC Meeting held on June 23, 2012. Letter No. PEC/EA&QEC/HITEC-T/CL-63/2012, dated 06th Aug 2012 **The program accredited for a period of two years.** **Number of graduates Session 2008 = 176** **Number of graduates Session 2009 = 116**

8. Central OBE Committee

The Central OBE Committee (COBEC) is responsible for the overall monitoring of the outcome-based education in the University. The composition of the committee is given below:

S. No.	Name	Status
1.	The Vice Chancellor	Chairman
2.	All Deans	Member
3.	Director QA&C	Member
4.	Two Chairpersons (to be nominated by the Vice Chancellor)	Member
5.	Deputy Director QA&C	Member/Secretary

Responsibilities:

1. Policy decisions regarding OBE
2. Implementation/monitoring of the outcome-based education in the University.
3. To monitor/examine the proceedings of the departmental program committee.
4. To examine SAR prepared by the department before submission to PEC
5. Any other relevant task in context of OBE.

9. Departmental Program Committee (DPC)

The Departmental Program Committee (DPC) is responsible for the overall monitoring of the program. The composition of the committee is given below:

S. No.	Name	Status
1.	To be appointed by Chairperson	Convener
2.	No of persons to be decided by the Chairperson subject to the strength of students	Members
3.	OIC DQEC	Member
4.	One of the members shall be the secretary to be decided by the Chairperson	Member/Secretary

Formulation:

1. Chairperson of respective department shall propose the committee
2. Dean of the concerned Faculty shall approve the committee and,
3. Registrar shall notify the committee.

Responsibilities:

1. To manage and review the continuous improvement processes of program.
2. To review and recommend to BoS any actions or changes suggested by Departmental Quality Enhancement Cell (DQEC).
3. To assess the achievement of program objectives, outcomes and curriculum from the data provided by DQEC.

4. Preparation of SAR in coordination with all concerned stake holders.
5. Any other relevant task assigned by the Chairperson.

10. Departmental Quality Enhancement Cell (DQEC)

The composition of the committee is given below:

S. No.	Name	Status
1.	To be appointed by Chairperson	Officer In charge
2.	No of persons to be decided by the Chairperson subject to the strength of students	Members
3.	OIC DQEC may coopt one or two members with the permission of Chairperson for CQI cycle	Member
4.	One of the members shall be the secretary to be decided by the Chairperson	Member/Secretary

Responsibilities for DQEC

1. The DQEC shall function under the Chairperson of the department.
2. Coordination in teaching and learning activities amongst the stakeholders in the Department/ University.
3. Implementation of policies/ decision issued by the University.
4. Continuous Quality Improvement CQI analysis under OBE.

a) CQI at CLO Level

- To verify that CLOs of the subject are in line with approved PLOs and Bloom Taxonomy levels.
- To analyze CLO assessment methods and tools.
- To recommend and report to the DPC for appropriate actions of continuous quality improvement at CLO level for each subject after reviewing the results of CLO attainments and course feedback.
- Any other work assigned by DPC related to CLO attainment and assessments.

b) CQI at PLO level

- To conduct CQI of PLOs at individual and cohort level
- To collect and evaluate PLO attainment data every semester.
- To review PLO attainment data at student level after every semester for individual student PLO review and mentoring.
- To review subject PLO attainment data at cohort level every semester.
- To evaluate and review the graduating students exit survey and internship surveys in coordination with Directorate of QA&C for indirect assessment of PLOs.
- To analyze PLO assessment methods and tools.
- To verify the course folders, record for PLO attainment.

- To recommend and report the DPC for appropriate actions of continuous quality improvement of PLO at cohort level after reviewing the results of direct and indirect PLO assessments.
- Any other work assigned by DPC related to PLO attainment and assessments.

c) CQI at PEO level

- To evaluate and review alumni, exit and employer survey data in coordination with Directorate of QA&C for indirect assessment of PEOs.
- To help Directorate of QA&C in keeping the record/database of all alumni and employer and the updating of these databases every year.
- To recommend and report the DPC for appropriate actions of continuous quality improvement at PEO level.
- Any other work assigned by DPC related to PEO attainment and assessments.

11. Program Educational Objectives (PEOs)

After four years, the graduates of the program will be able to exhibit the following computational skills:

Program Specific

PEO-1	
PEO-2	
PEO-3	
PEO-4	

12. Mapping of PEOs to University Vision & Mission and Departmental Mission

Program Specific

Vision and Mission		**Program Educational Objectives (PEOs)**			
		PEO-1	**PEO-2**	**PEO-3**	**PEO-4**
University Vision					
University Mission					
Program's Mission					

13. Program Learning Outcomes (PLOs)

Program Specific (11 or 12 PLOs)

PLO-1	
PLO-2	
PLO-3	
PLO-4	
PLO-5	
PLO-6	
PLO-7	
PLO-8	
PLO-9	
PLO-10	
PLO-11	
PLO-12	

14. Mapping of PLOs to PEOs

Program Specific (11 or 12 PLOs)

Program Learning Outcomes (PLOs)		**Program Educational Objectives (PEOs)**			
		PEO-1	**PEO-2**	**PEO-3**	**PEO-4**
PLO-1	Engineering Knowledge				
PLO-2	Problem Analysis				
PLO-3	Design/Development of Solutions				
PLO-4					
PLO-5					
PLO-6					
PLO-7					
PLO-8					
PLO-9					
PLO-10					
PLO-11					
PLO-12					

15. Mapping of Bachelor of Engineering Program with Sustainable Development Goals (SDGs)

Program Specific

Sr. No.	Description	Sustainable Development Goals (SDGs)																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	HEI vision and mission with focus on specific engineering program																	
2	Bachelor of Engineering Curriculum (Engg. & Non-Engg. Courses)																	
3	Final Year Design Project (FYDP)																	
4	Other pre-requisite activities (Internship, Community service, Survey camp, etc.)																	
5	Co- and Extra- Curricular Activities																	

16. Engineering Competencies (ECs)

EC-01	**Comprehend and apply universal knowledge**: Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practices.
EC-02	**Comprehend and apply local knowledge**: Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction of practices.
EC-03	**Problem analysis**: Define, investigate and analyze complex Engineering problems using data and information technologies where applicable.
EC-04	**Design and development of solutions**: Design or develop solutions to complex Engineering problems considering a variety of perspectives and taking account of stakeholder views.
EC-05	**Evaluation**: Evaluate the outcomes and impacts of complex Engineering activities.
EC-06	**Protection of society**: Recognize the foreseeable economic, social, and environmental effects of complex Engineering activities and seek to achieve sustainable outcomes.
EC-07	**Legal, regulatory, and cultural**: Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all Engineering activities.
EC-08	**Ethics**: Conduct Engineering activities ethically.
EC-09	**Manage engineering activities**: Manage part or all of one or more complex Engineering activities.
EC-10	**Communication and Collaboration**: Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all Engineering activities.
EC-11	**Continuing Professional Development (CPD) and Lifelong learning**: Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever- changing nature of work.
EC-12	**Judgement**: Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of all complex Engineering activities.
EC-13	**Responsibility for decisions**: Be responsible for making decisions on part or all of complex Engineering activities.

17. Scheme of Studies (Program Specific)

BS _____ Engineering

First Year

First Semester (Fall Semester)					Second Semester (Spring Semester)				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
Total					Total				

Second Year

Third Semester (Fall Semester)					Fourth Semester (Spring Semester)				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
Total					Total				

Third Year

Fifth Semester (Fall Semester)					Sixth Semester (Spring Semester)				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
Total					Total				

Final Year

Seventh Semester (Fall Semester)					Eighth Semester (Spring Semester)				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
Total					Total				

** Duration one academic year: Requires literature survey and preliminary work during this Semester*

Course Code	Course Names (Electives)

18. Mapping of Curriculum to PLOs (Program Specific)

Courses				Program Learning Outcomes PLOs										
		Course Code	Course Title	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11
1st Year	1st Semester													
	2nd Semester													
2nd Year	3rd Semester													
	4th Semester													
3rd Year	5th Semester													
	6th Semester													
4th Year	7th Semester													
	8th Semester													

19. Curriculum with Learning Levels (Program Specific)

Courses					Cognitive						Psychomotor						Affective					
		Course Code	**Course Title**	**PLO**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**A1**	**A2**	**A3**	**A4**	**C1**
1st Year	**1st Semester**	1																				
		2																				
	2nd Semester	1																				
		2																				
2nd Year	**3rd Semester**	1																				
		2																				
	4th Semester	1																				
		2																				
3rd Year	**5th Semester**	1																				
		2																				
	6th Semester	1																				

		2																				
4th Year	**7th Semester**	1																				
		2																				
	8th Semester	1																				
		2																				

20. Courses with Learning Level in K-P-A Domains (Program Specific)

	Cognitive Domain			Psychomotor Domain			Affective Domain		
	No. of Courses	**Maxi Level**	**Mini Level**	**No. of Courses**	**Maxi Level**	**Mini Level**	**No. of Courses**	**Maxi Level**	**Mini Level**
1st Semester									
2nd Semester									
3rd Semester									
4th Semester									
5th Semester									
6th Semester									
7th Semester									
8th Semester									
FYDP									
Internship									
Community Services									
Overall									

21. Correlation Matrix PLOs-ECs-WKs-SDGs

PLOs		ECs	WKs	SDGs
PLO-1	Engineering Knowledge			
PLO-2	Problem Analysis			
PLO-3	Design/Development of Solutions			
PLO-4	Investigation			
PLO-5	Tool Usage			
PLO-6	The Engineer and the World			
PLO-7	Ethics			
PLO-8	Individual and Collaborative Team Work			
PLO-9	Communication			
PLO-10	Project Management and Finance			
PLO-11	Lifelong Learning			

**** Sample is available in appendix-I***

22. Complex Engineering Problem (Program Specific)

Year		Semester	Course Code	Course Title

**** Characteristics of CEP are available in appendix-II***

23. Open-Ended Lab (Program Specific)

Year	Semester	Course Code	Course Title

24. Key Performance Indicators (KPIs)

		Evaluation Strategy	KPI		Frequency		Remarks
			KPI Indicator	KPI Target Value	Data Collection	Analysis	
PEO	Program Level	**Indirect**	Score of Employer Survey Form	At least 60% of the Survey Form responses must attain a score of 3 or above on a scale of 1 to 5.	Every Year	4 –Years From Graduation	PEO Attainment
			Score of Alumni Survey Form	At least 60% of the Survey Form responses must attain a score of 3 or above on a scale of 1 to 5.			PEO Attainment
PLO	Student Level (Individual)	**Direct**	CLO scores of the student in the mapped course(s)	Each student must obtain at least 50% score in CLO to attain mapped PLO with it.	Every Semester	Every Semester	PLO Attainment
	Course Level (Cohort)	**Direct**	PLO scores of all the students in the mapped course	At least 50% of the students must attain relevant PLO	Every Semester	Every Semester	PLO Attainment
	Program Level	**Direct**	Final PLO attainment statistics of all the courses including FYDP	Each student must attain all PLOs in 50% of a total number of relevant courses.	At graduation	At graduation	PLO Attainment
		Indirect	Exit Survey Result	At least 60% of the Survey Form responses must attain a score of 3 or above on a scale of 1 to 5.			PLO Attainment
		Indirect	Internship Survey Result	At least 60% of the students responses must attain a score of 3 or above on a scale of 1 to 5.			PLO Attainment

		Evaluation Strategy	KPI		Frequency		Remarks
			KPI Indicator	KPI Target Value	Data Collection	Analysis	
CLO	Student Level (Individual)	Direct	CLO score of the student	The student must obtain at least 50% score to attain relevant CLO.	Every Semester	Every Semester	CLO Attainment
	Course Level (Cohort)	Direct	CLO scores of all students in the course	At least 50% students in the course must attain relevant CLO	Every Semester	Every Semester	CLO Attainment

25. Continuous Quality Improvement (CQI)

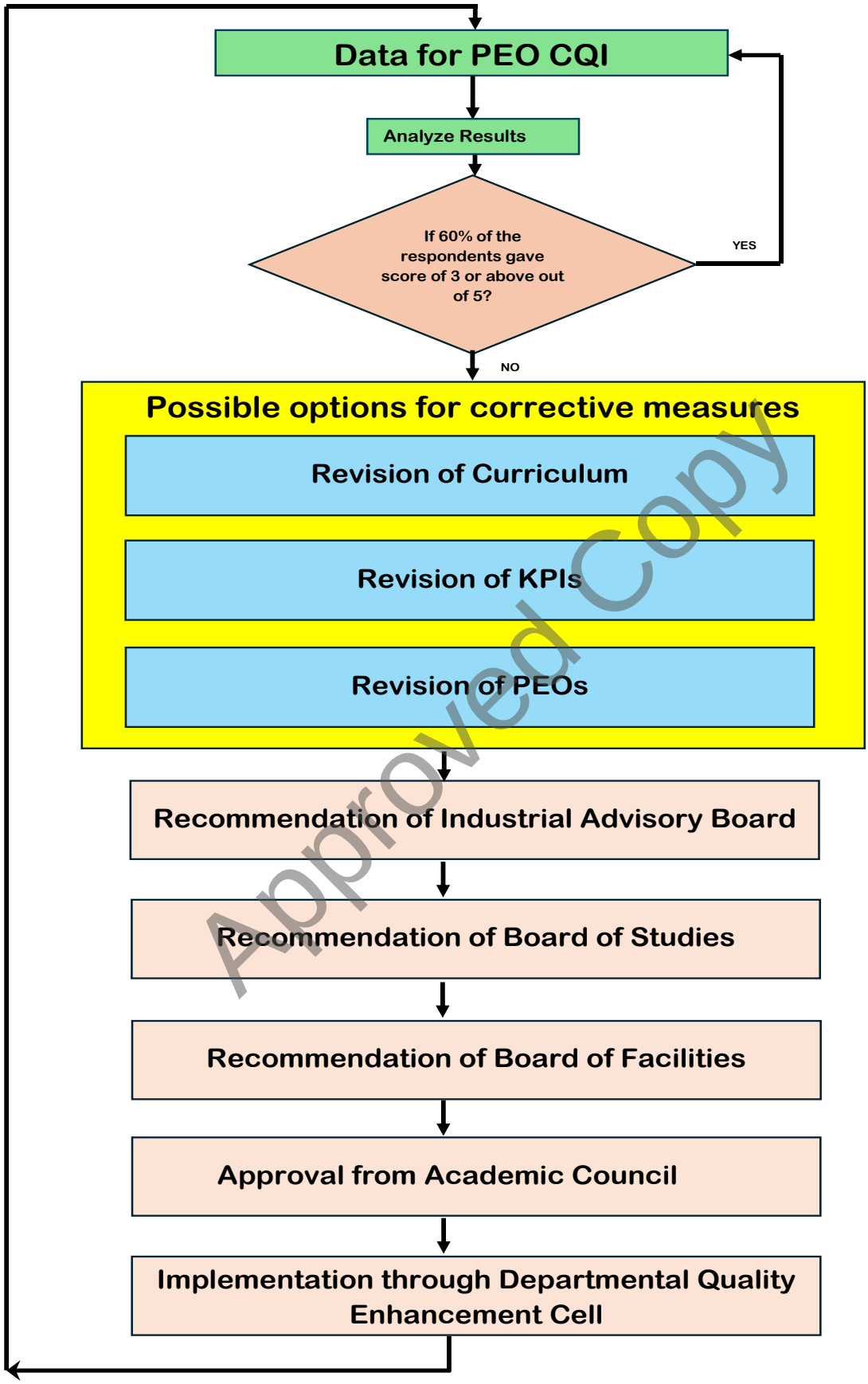
PEO CQI		
Program KPI		
KPI Achieved	Analyze the result and suggest recommendations if required.	
KPI Not Achieved	**Possible Options for Corrective Measure**	
	a.	Revision of Curriculum
	b.	Revision of KPIs
	c.	Revision of PEOs
	Implementation Steps for Corrective Measures	
	a.	Recommendation of Industrial Advisory Board
	b.	Recommendation of Board of Studies
	c.	Recommendation of Board of Faculty
	d.	Approval from Academic Council
	e.	Implementation through departmental quality enhancement cell (DQEC).

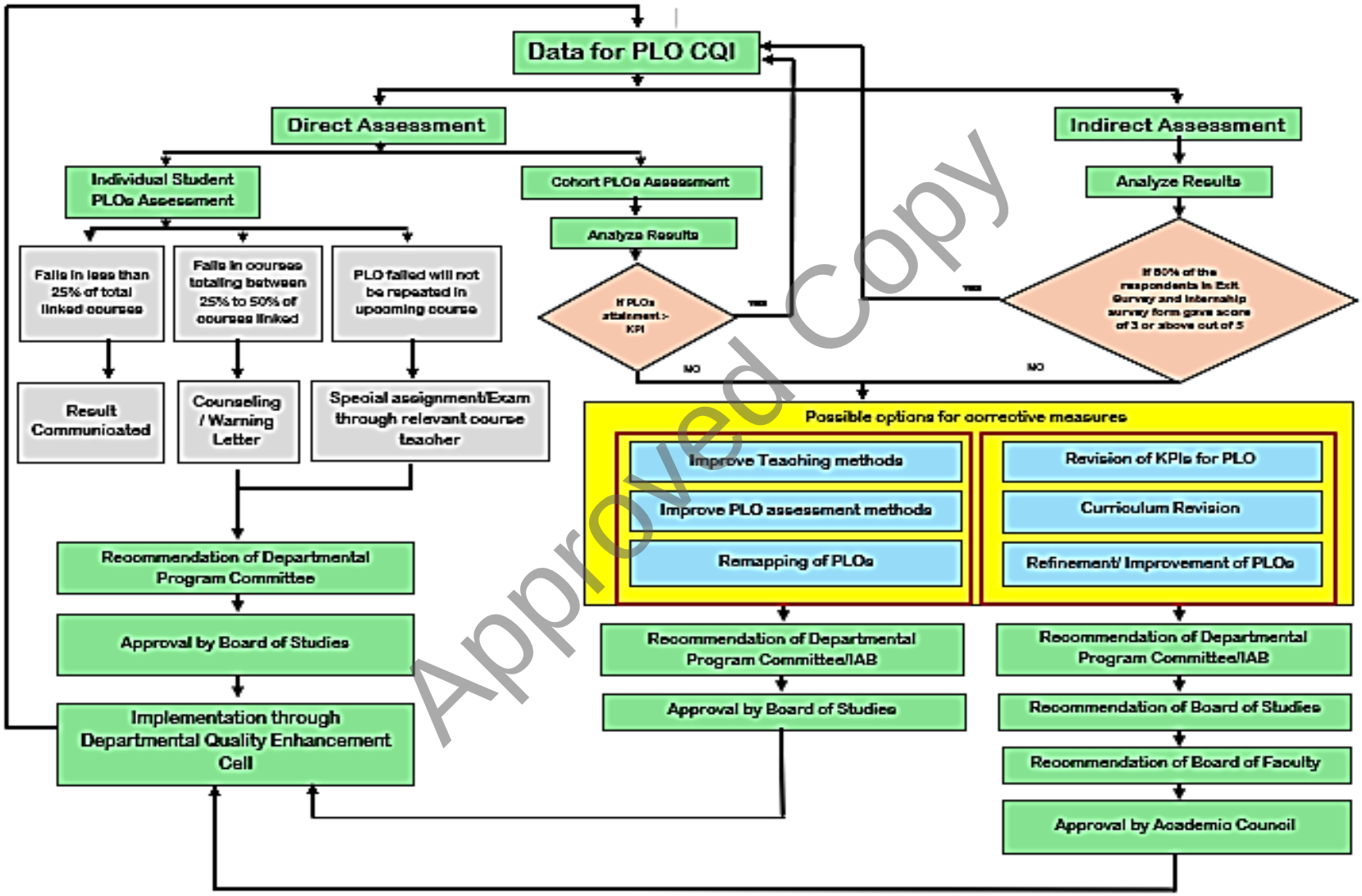
PLO CQI		
Program KPI		
KPI Achieved	Analyze the result and suggest recommendations if required.	
KPI Not Achieved	**Direct Assessment**	
	a.	**Individual student PLO assessment**
		Possible Corrective Measures: a) Result is communicated if student fails in up to 25% of total PLO assessment. b) Counseling/ Waring is given if student fails between 25% to 50% of total PLO assessment. c) Special assignments/exams can be given if student fails in 50% or more of the PLO assessment. **Implementation Steps for Corrective Measures** i. Recommendation by Program Committee. ii. Approval by Board of Studies. iii. Implementation through departmental quality enhancement cell (DQEC).
	b.	**Assessment at Cohort Level**
		i. If PLOs attainment is greater than KPI then analyze the result and suggest recommendations if required. ii. Otherwise, possible corrective measures list below: **Possible Corrective Measures:** a) Improve teaching methods b) Improve PLO assessment methods. c) Remapping of PLOs with CLOs. d) Revision of KPIs for PLO.

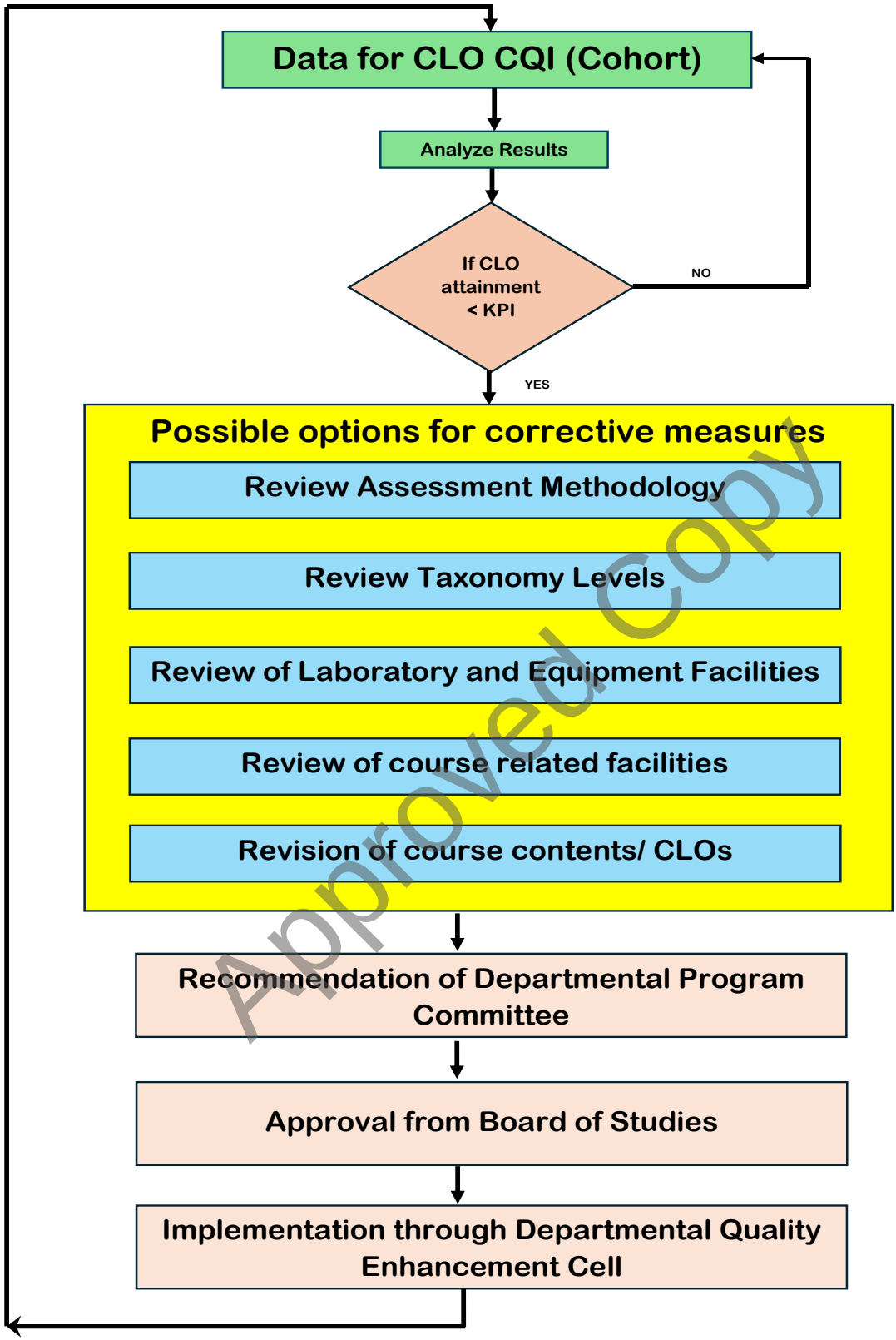
		e) Curriculum Revision. f) Refinement/ Improvement of PLOs. **Implementation Steps for Corrective Measures** **For corrective measures a, b and c** i. Recommendation of Program Committee/ IAB. ii. Approval by Board of Studies. **For corrective measures d, e and f** i. Recommendation of Program Committee/ IAB. ii. Recommendation of Board of Studies. iii. Recommendation of Board of Faculty. iv. Approval by the Academic Council. Implementation through departmental quality enhancement cell (DQEC).
	Indirect Assessment	
		i. If 60% of the responses in exit / internship survey gives score of 3 or above on a scale of 1 to 5 then analyze the results and give recommendations if required. ii. Otherwise, possible corrective measures list below: a) Review of PLO assessment method. b) Remapping of PLOs. c) Revision of KPIs for PLO. d) Curriculum Revision. e) Refinement/ Improvement of PLOs. f) Revision of Survey tools **Implementation Steps for Corrective Measures** **For corrective measures a and b** i. Recommendation of Program Committee/ IAB. ii. Approval by Board of Studies. **For corrective measures c, d and e** i. Recommendation of Program Committee/ IAB. ii. Recommendation of Board of Studies. iii. Recommendation of Board of Faculty. iv. Approval by the Academic Council. Implementation through departmental quality enhancement cell (DQEC).

CLO CQI		
Program KPI		
KPI Achieved	Analyze the result and suggest recommendations if required.	
KPI Not Achieved	**Possible Options for Corrective Measure**	
	a.	Review Assessment Methodology
	b.	Review Taxonomy Levels
	c.	Review of Laboratory and Equipment Facilities
	d.	Review of course related facilities
	e.	Revision of course contents/ CLOs
	Implementation Steps for Corrective Measures	

	a.	Recommendation of Program Committee
	b.	Approval from Board of Studies
	c.	Implementation through departmental quality enhancement cell (DQEC).







26. Appendix-I

PLOs	ECs *	WKs	SDGs (Proposed)
PLO-1 **Engineering Knowledge:** Breadth, depth and type of knowledge, both theoretical and practical	**EC-1** **Comprehend and apply universal knowledge,** & **EC-2** **Comprehend and apply local knowledge**	(WK-1, WK-2, WK-3 & WK-4) **WK-1** **Natural sciences and awareness of relevant social sciences** **WK-2** **Mathematics & computing** **WK-3** **Engineering fundamentals** **WK-4** **Engineering specialist knowledge**	SDG-9
PLO-2 **Problem Analysis:** Complexity of analysis	**EC-3** **Problem analysis**	(WK-1, WK-2, WK-3 & WK-4) **WK-1** **Natural sciences and awareness of relevant social sciences** **WK-2** **Mathematics & computing** **WK-3** **Engineering fundamentals** **WK-4** **Engineering specialist knowledge**	Selected SDGs from SDG - 1 to 17 (relevance as per curriculum)

27. Appendix-II

	Characteristic	A **Complex Computing Problem** is a computing problem having some or all of the following characteristics:
1	Range of conflicting requirements	Involves wide-ranging or conflicting technical, computing, and other issues
2	Depth of analysis required	Has no obvious solution, and requires conceptual thinking and innovative analysis to formulate suitable abstract models
3	Depth of knowledge required	A solution requires the use of in-depth computing or domain knowledge and an analytical approach that is based on well-founded principles
4	Familiarity of issues	Involves infrequently-encountered issues
5	Level of problem	Is outside problems encompassed by standards and standard practice for professional computing
6	Extent of stakeholder involvement and level of conflicting requirements	Involves diverse groups of stakeholders with widely varying needs
7	Consequences	Has significant consequences in a range of contexts
8	Interdependence	Is a high-level problem possibly including many component parts or sub-problems
9	Requirement identification	Identification of a requirement or the cause of a problem is ill defined or unknown