

MANAKULA VINAYAGAR INSTITUTE OF TECHNOLOGY

(Approved by AICTE, Affiliated to Pondicherry University and Accredited by NBA) Kalitheerthalkuppam,Puducherry - 605 107

Outcome Based Education (OBE) Manual

Academic Year 2022-23



Preface

Outcome Based Education (OBE) is an educational theory that can improve the quality of education delivered to young minds by means of setting a specified outcome. The outcome based education gives a very good flexibility to faculty and students in achieving their goals by adopting varied teaching and learning tools according to their capacity. The main objective is ultimately to improve the quality of the graduates. The traditional methods of teaching is augmented by addition of measurable and realizable goals and are clearly evident by adopting outcome based education.

Benefits of OBE

- \Rightarrow The Students are more clear on the goals and are more relevant for current industrial demands at the end of graduation.
- ⇒ OBE provides an avenue for restructuring the curriculum and assessment procedures in education and involves higher order learning and mastery than conventional educational systems.
- \Rightarrow OBE promotes more student involvement in learning and also increases responsibility among students and provides a platform to demonstrate their abilities.
- ⇒ OBE provides better communication between teachers and students and improves students performance as they know what is expected and what is assessed.
- \Rightarrow OBE can provide a good strategy for continuous improvement.

India, OBE and Accreditation

From 13th June 2014, India has become the permanent signatory member of the Washington Accord. Implementation of OBE in higher technical education also started in India. The National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) are the autonomous bodies for promoting global quality standards for technical education in India. NBA has started accrediting only the programs running with OBE from 2013. The National Board of Accreditation mandates establishing a culture of outcome based education in institutions that offer Engineering, Pharmacy, Management program. Reports of outcome analysis help to find gaps and carryout continuous improvements in the education system of an Institute, which is very essential.

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- 1. Blooms Taxonomy usage
- 2. Program Outcomes- Competencies-Performance Indicators.

Vision and Mission of the Institute

`Vision

To be a globally reputed Technical Institution creating Competent leaders and Skillful innovators in Science, Technology and Management.

Mission

- * Providing a dynamic and creative learning environment for its students to acquire exemplary technical, analytical, professional skills.
- Imbibing a spirit of innovation and research among its students and faculty for solving critical problems.
- * Promoting Innovation, Employability and entrepreneurship skills through industry academia collaboration.
- * Serving the society through technical intervention and creating socially responsible Professionals.

Core Values

Technology based Education Industry interaction Green campus Community development Global vision Commitment to excellence Social Responsibility

obe Enactment





Procedure to be followed for Implementing OBE

- Every faculty member must write Course Outcomes (COs) for the subject allotted to them.
- The Course Outcomes are written with Bloom's Taxonomy action verbs indicating the cognitive level at which the faculty plans to teach based their expertise.
- CO PO mapping has to be done using Blooms Taxonomy correlation level between written CO and POs.
- Activities and Assessment tools should be planned for each of the mapped values in CO-PO matrix.
- Faculty have to Prepare the Test items for the above CO-PO matrix based on Competency level and Performance Indicators.
- Faculty should plan and conduct activities like Quiz, Chart presentation, Assignment etc., for matrix values in the CO-PO map that is not covered by the Test Items.
- Faculty must take course Exit survey at the end of the semester for their subjects to get indirect attainment of COs.
- Faculty must calculate the CO attainments for each subject from the Internals exams results and university results. The PO attainments are calculated from CO-PO map values.
- Department will collect surveys for PO Indirect attainment and calculate the overall attainment.
- ▲ The Department Committee will verify the above process regularly.
- The scope for improvement and fixing targets for next academic years will be decided at the end of each academic year by Department Committee.

BLOOMS TAXONOMY Understanding Various Levels of Bloom's Texonomy



Source: teachingutopians.com

Note:

- The end semester written examinations can assess only very limited course outcomes and program outcomes.
- It means written examinations of time bound duration are not sufficient to make valid judgement about student learning.
- Therefore, some alternative assessment methods like problem solving assignments, projects portfolios etc. are required to assess the higher order skills at level 4, 5 and 6.

Top three levels i.e., Creating, Evaluating and up to some extent Analyzing are to be assessed by extended course works like projects, internship experiences and e-portfolios of students. Adoption of Bloom's Level framework should be implemented at university level for the sake of uniformity and to provide same playing field to all students regarding:

- Mapping of questions in the written examinations with Course Outcomes and then with Program Outcomes.
- Weightage of Bloom's Level attached to each question in the question paper.
- Criteria of assessment with mapping of questions in the viva-voce with Course Outcomes and then with Program Outcomes.
- Characteristics which are to be assessed.
- A rating scale which defines student's ability within each criterion.
- Mapping of scale with Course outcomes and hence Program outcomes.

Bloom's level	Description Attainment of Skill	Attainment of Skill
1	Remembering	Memorization of facts or knowledge attained in class or by reading the subject material.
2	Understanding	Explanation of previously learned material, ideas or concepts.
3	Applying	Use of knowledge attained for the application in another similar situa- tion.
4	Analyzing	Split the information into parts and to find relationships between them and able to analyze.
5	Evaluating	Based on the work done and knowledge to justify the decision taken.
6	Creating	Develop and design a new concept or to generate a new idea while solving a problem.

Assessment Tools for Different Bloom's Levels



Learning Domains

"**Domains of learning**" refers to the three separate, yet interdependent components of learning outcomes achievable by human learners. These domains--cognitive, affective, and psychomotor represent various categories and levels of learning complexity and are commonly referred to as educational taxonomies.

The cognitive domain (knowledge) refers to knowledge attainment and mental/intellectual processes.

The affective domain (attitude or self) characterizes the emotional arena reflected by learners' beliefs, values and interests.

The psychomotor domain (manual or physical skills) reflects learning behavior achieved through neuromuscular motor activities.



Courtesy: https://tell.colvee.org/

The Revised Blooms Taxonomy in the cognitive Domain. This new taxonomy reflects a more active form of thinking and is perhaps more accurate.



Revised Bloom's Action Verbs for Course Outcomes

Remember	Understand	Apply	Analyze	Evaluate	Create
Arrange	Alter	Apply	Analyze	Appraise	Arrange
Cite	Classify	Change	Appraise	Argue	Assemble
Define	Convert	Choose	Ascertain	Assess	Collect
Identify	Defend	Compute	Associate	Attach	Combine
Label	Describe	Demonstrate	Breakdown	Choose	Comply
List	Discuss	Discover	Calculate	Compare	Compose
Memorize	Explain	Dramatize	Categorize	Conclude	Conceive
Match	Express	Draw	Compare	Critique	Construct
Name	Extend	Employ	Conclude	Deduce	Create
Order	Generalize	Illustrate	Contrast	Defend	Derive
Outline	Give examples	Interpret	Criticize	Estimate	Design
Pronounce	Indicate	Manipulate	Designate	Evaluate	Develop
Quote	Locate	Modify	Determine	Judge	Devise
Recall	Paraphrase	Operate	Diagnose	Justify	Expand
Recite	Recognize	Practice	Diagram	Predict	Extend
Recognize	Rephrase	Prepare	Differentiate	Prove	Formulate
Repeat	Restate	Produce	Discriminate	Rate	Generalize
Reproduce	Reword	Schedule	Distinguish	Review	Generate
State	Rewrite	Show	Divide	Support	Integrate
	Select	Sketch	Examine	Value	Invent
	Summarize	Solve	Experiment	Weigh	Modify
	Translate	Use	Find		Originate
			Infer		Plan
			Outline		Prepare
			Point out		Project
			Question		Rearrange
			Reduce		Reconstruct
			Relate		Reorganize
			Separate		Revise
			Specify		Set up
			Subdivide		Synthesize
			Test		

Courtesy : IIT-KGP

Cognitive domain

The cognitive domain is focused on intellectual skills such as critical thinking, problem solving, and creating a knowledge base. It was the first domain created by the original group of Bloom's researchers. The cognitive hierarchy spans from simple memorization designed to build the knowledge of learners, to creating something new based on previously-learned information. In this domain, learners are expected to progress linearly through the hierarchy, beginning at "remember" and ending at "create."

When writing your own learning outcomes, we encourage you to choose verbs that best describe what is expected (e.g., for remember, you might consider define, identify, list, recall, recognize, match, etc.). A search for "Bloom's Verbs" will provide lists of synonyms to use.

Course Outcome Formation

What should an CO contain ?

Course Outcome (CO) describe what students are able to demonstrate in terms of knowledge, skills, and values upon completion of a course. Clear articulation of learning outcomes serves as the foundation to evaluating the effectiveness of the teaching and learning process.

Effective, learning objectives need to be specific, observable and measurable statements



The Components of a Measurable Course Outcome.

Three essential components of a measurable Course Outcome are:

- Student learning behaviors
- Appropriate assessment methods
- Specific student performance criteria / criteria for success When writing a measurable Course Outcome, it is important to:
 - \Rightarrow focus on student behavior
 - \Rightarrow use simple, specific action verbs
 - \Rightarrow select appropriate assessment methods
 - \Rightarrow state desired performance criteria

Focus on Student Behavior.

Course Outcomes are about what students are able to demonstrate upon completion of a course. Course Outcomes are not about what the instructors can provide but what the students can demonstrate. The following are <u>not</u> Course Outcomes:



X Offer opportunities for students to master integrated use of information technology.

The program will engage a significant number of students in a formalized language/ cultural studies program.



- Students who participate in critical writing seminars will write two essays on critical thinking skills.
- Students will be exposed to exceptionality in learning disabilities including visual and perception disabilities.

Use Simple, Specific Action Verbs.

When writing Course Outcomes, focus on student behavior and use simple, specific action verbs to describe what students are expected to demonstrate.

The following are examples of Course Outcomes:

- Students will be able to <u>collect</u> and <u>organize</u> appropriate clinical data (history, physical exam, laboratory assessments including technology advancements in diagnostic such as PCR).
- Students will be able to <u>apply</u> principles of evidence-based medicine to determine clinical diagnoses, and formulate and implement acceptable treatment modalities.
- Students will be able to <u>articulate</u> cultural and socioeconomic differences and the significance of these differences for instructional planning.
- Students will be able to <u>use</u> technology effectively in the delivery of instruction, assessment, and professional development.

Note: Bloom's Taxonomy can be a useful resource in developing Course Outcomes.

Δ	СТ	0	Ν	VE	RB	S

Concrete verbs such as "define," "apply," or "analyze" are more helpful for assessment than verbs such as "be exposed to," "understand," "know," "be familiar with."

Cognitive Learning Remember- to recall or remember facts without necessarily understanding them	Action Verbs: arrange, define, duplicate, label list, memorize, name, order, recognize, relate, recall, reproduce, list, tell, describe, iden- tify, show, label, collect, examine, tabulate, quote
Understand – to understand and interpret learned information	classify, describe, discuss, explain, express, interpret, contrast, predict, associate, distinguish, estimate, dif- ferentiate, discuss, extend, translate, review, restate, locate, recognize, report
Apply– to put ideas and concepts to work in solving problems	apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, calculate, complete, show, examine, modify, relate, change, experiment, discover
Analyze– to break information into its components to see interrelationships and ideas	analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test, separate, order, connect, classify, arrange, divide, infer
Evaluate– to judge the value of infor- mation based on established criteria	appraise, argue, assess, attach, defend, judge, predict, rate, support, evaluate, recommend, convince, judge, con- clude, compare, summarize
Create – to use creativity to compose and design something original	arrange, assemble, collect, compose, construct, create, de- sign, develop, formulate, manage, organize, plan, prepare, propose, set up, rewrite, integrate, create, design, generalize

Select Appropriate Assessment Methods.

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

Examples of Direct Assessment Methods:	Examples of Indirect Assessment Methods:
Internal assessment	Course Exit Surveys after end of each course
University Examinations	Employer surveys
Certification exams	Program Exit Survey
Assignments	Alumni surveys
Mini-projects	
major project	
Internship evaluations	
Grading with scoring rubrics*	
Comprehensive exams	

State Desired Performance Criteria.

Performance criteria express in specific and measurable/observable terms that are acceptable to a specific course or program. Note that grades alone do <u>not</u> provide adequate feedback to students' performance because grades represent overall competency of students and do not identify strengths and weaknesses on specific Course Outcomes. However, if the grading system is tied to rubrics, it can be a useful tool to identify areas for improvement that should be addressed. The following is <u>not</u> an acceptable measurable Course Outcome:

Students will be able to communicate effectively, as demonstrated by obtaining at least a "C" grade in the course.

With slight modification, the above Course Outcome can be stated in measurable terms.

Students will be able to communicate effectively, as exhibited by scoring at least 8 out of 10 for all the components within the grading criteria on the final writing assignment.

Parts of a Course Outcome Statement

Performance: is a description of what learners will be able to do at the end of the learning experience. It is designated by an **action verb** so that it is *observable*.

Conditions: define the conditions in which learners will perform the learning tasks. This is what makes your learning objective specific.

Criteria: define how learners will be assessed. This component of your learning objective is what makes it *measurable*.



Example :

At the end of this lesson, you will be able to:



Performance

Condition

"What learners must be able Describes the condition under The criteria will tell the level of to DO or PERFORM when which the learner performs an proficiency that is expected and it they demonstrate mastery of action. an objective."

You may answer Questions You may answer Questions like "What will you give the like "What will the person be person to use?"

able to do after learning the "what will be the environment?"

Example

- 1. Be able to write a news 1. using a Calculator article.
 - 2. Using a transform in mathematics
 - 3. Using a scale
 - 4. In the daylight
 - 5. Using a tool.

will tell how the learner will perform in terms of quantity, quality, and/or time measurements.

Criteria

You may answer questions like "How many?" "How fast?" " How well?"

Example

- 1. Within 10 minutes
- 2. 80% or better
- 3. In compliance with the chart
- 4. Within acceptable industrial standards.

2. Construct a model car ..

topic?"

Example

3. Solve mathematically

Program Outcomes

PO1: Engineering knowledge: Apply knowledge of mathematics and science, with fundamentals of Engineering and Technology to be able to solve complex engineering problems related to Computer Science and Engineering.

PO2: Problem analysis: Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems related to CSE 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.

PO4: 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.

PO5: Modern tool usage: Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: 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

CO-PO Course Articulation Matrix Mapping

Course Articulation Matrix shows the educational relationship (Level of Learning achieved) between Course Outcomes and Program Outcomes for a Course. This matrix strongly indicates whether the students are able to achieve the course learning objectives. The matrix can be used for any course and is a good way to evaluate a course syllabus.

The Table gives information about the action verbs used in the POs and the nature of POs, stating whether the POs are technical or non-technical. We need to understand the intention of each POs and the Bloom's level to which each of these action verbs in the POs correlates to.

Туре	Program	Action Verb(s)	Bloom's level(s)
	Outcomes	III FOS	101 POS
	1	Apply	L3
		Identify	L2
	2	Formulate	L6
		Review	L2
	3	Design	L6
Technical	5	Develop	L3
reennear		Analyze	L4
	4	Interpret	L2
		Design	L6
		Create	L6
	5	Select	L1,L2
		Apply	L3
	6		
	7		
	8	Rule of	f thumb
Non Technical	9		
	10		
	11		
	12		

Rule for CO-PO Mapping

- If the cognitive (Bloom's) level of the CO is same as that of the PO Level then the mapping is of high correlation i.e. Matrix value is 3.
- If the CO level is one less than the PO level than the correlation is Moderate and Matrix value is 2.
- If the CO level is less than the PO level by more that 2 or above than the correlation is weak and Matrix value is 1.

Note : Mapping values are to be entered only if the teacher is competent enough to ask a test item or any activity justifying the relation of a particular CO-PO. Otherwise the correlation is zero.

Thumb Rule for CO-PO Mapping

 If Bloom's L1 Action Verbs of a CO Correlates with any of PO6 to PO12 and assessment tool is planned by teacher then assign 1.

 If Bloom's L2 to L3 Action Verbs of a CO Correlates with any of PO6 to PO12 -and assessment tool is planned by teacher then assign 2.

 If Bloom's L4 to L6 Action Verbs of a CO Correlates with any of PO6 to PO12 and assessment tool is planned by teacher then assign 3

List of Assessment Tools

CO Assessment Tools

- \Rightarrow Internal Test
- \Rightarrow Model Test
- \Rightarrow University Exam
- \Rightarrow Practical/ Lab model exam
- \Rightarrow Industrial Visit
- \Rightarrow Workshops
- \Rightarrow Quiz
- \Rightarrow Assignment
- \Rightarrow Special /Invited Lectures
- \Rightarrow Projects
- \Rightarrow Seminar
- \Rightarrow Course Exit Survey
- \Rightarrow External Feedback

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Direct Tools: (Measurable in terms of marks and w.r.t. CO)

Indirect Tools: (Non measurable in terms of marks and w.r.t. CO)



Test Item

The Test Item is to prepare the faculty for justifying the correlation of CO –PO matrix.

The Cognitive levels have identified five Dimensions (Clark, Chopeta, 2004; Clark, Mayer, 2007):

- Facts Specific and unique data or instance.
- **Concepts** A class of items, words, or ideas that are known by a common name, includes multiple specific examples, shares common features. There are two types of concepts: concrete and abstract.
- **Processes** A flow of events or activities that describe how things work rather than how to do things. There are normally two types: business processes that describe work flows and technical processes that describe how things work in equipment or nature. They may be thought of as the big picture, of how something works.
- **Procedures** A series of step-by-step actions and decisions that result in the achievement of a task. There are two types of actions: linear and branched.
- **Principles** Guidelines, rules, and parameters that govern. It includes not only what should be done, but also what should not be done. Principles allow one to make predictions and draw implications. Given an effect, one can infer the cause of a phenomena. Principles are the basic building blocks of causal models or theoretical models (theories).

Formation of Questions for Examinations

- Questions are Framed with appropriate Blooms taxonomy action verbs
- Consider the cognitive dimension for setting test items .
- The Performance Indicator is given for each Program Outcomes correlating with the cognitive Dimension. (Ref Annexure)

Example

Q.N 0	Questions	Marks	СО	BL	PI
1	Derive Electric field Intensity at the given point due to line charge of infinite length.	11	CO1	K5	1.1.1
2	Solve for E at a point P(1,2,1) due to a point charge of 2nC at (1,1,1) and another charge 3mC at (1,0,1)	11	CO1	K3	3.1.6
3	State Gauss's law and give examples for any two applications	11	CO1	K2	1.3.1

Target for CO and PO Attainment

CO Attainment Target is set differently for Internal Exams and University Exams

Internal Examinations



Part 1 : Individual Student Attainment

For each CO of a subject the student attains the CO $\,$ if he scores more than 50% of the total marks .

If the Student gets less than 50 % of total marks for each CO then he/she has not attained the respective CO .

Part 2 : Class Attainment



Threshold Levels^{*} for class attainment

Target attainment levels for Internal Exams

Attainment Level =1 if Total No. of students attained a CO is > 75%

Attainment Level =2 if Total No. of students attained a CO is > 85%

Attainment Level =3 if Total No. of students attained a CO is > 95%

[* The Threshold Level is Fixed Based on the Bloom's Taxonomy level of the CO written by the faculty. The Levels are preapproved by the Department head before start of the course.]

University Examinations

The average Pass percentage for the last three years of a subject is taken as Threshold value and the Attainment levels are set with 5% increase for each level.

Example. If the Average pass percentage for last three years of a subject is 75 %

Then the Attainment levels are set as

- i) Attainment level =1 if the current year pass percentage is 75% to 80% (low)
- ii) Attainment level =2 if the current year pass percentage is 80% to 85 % (medium)
- iii) Attainment level =3 if the current year pass percentage is 85% to 90% (High)

Target for Program Outcome Attainment

Average of PO attainments for Three Consecutive years



The Target for Next Academic year is selected based on the Average Value for each PO

Guidelines to Calculate the CO Attainment

- Calculating Course Outcomes (CO) involves calculations from the marks obtained by the students in their internal exams, Model exams, and university exams and the course exit survey received from the students at the end of the course.
- ▲ After the Conduction and evaluation of internal and model exams, attainment should be calculated for each students CO wise. Meanwhile, the attainment status of the individual student can also be found by fixing a threshold for every COs.
- ▲ The average is taken from the values of Percentage of students secured more than 50% of marks for each Question belongs to a specific CO. The format and calculation method is shown below in step-1.
- Having the values of each CO, an attainment level is fixed as 1, 2 & 3 by assigning a target (Internal Attainment).
- The target levels based on previous year results are used to assign an attainment level for the University exam result.
- ▲ 20% from the value of internal attainment and 80% from the value of University attainment have to be taken for calculating the direct Attainment.
- Also, a course exit survey has to be done for all the COs to calculate the indirect Attainment for the course.
- ▲ To calculate the overall attainment for the course, 90% of direct and 10% of indirect attainment is considered for each CO. This is shown below in step-2.
- ▲ The PO attainments is calculated from the CO attainment.

The steps involved in calculating the CO is shown below.

Step-1.

Eg.: Assessment II is taken for calculating CO2 & CO3.

Mana	kula Vinaya	gar Institute of Technology		Attai	nment	Level	Description															
Depa	artment of E	electronics and communicati	on engin		1		65%	and ab	ove bu	t less t	than 70)% of st	tudent	s scorii	ng 50%	marks	in the	releva	nt CO			
Inter	nal Assess	ment II			2		70%	and ab	ove bu	t less t	than 75	i% of st	tudent	s scorii	ng 50%	marks	in the	releva	nt CO			
Year	/Semester/	Sec :			3			M	ore tha	n 75%	of stud	lents s	coring	50% m	arks in	the rel	evant (0				
Subje	ect Name/O	ode:																				
Date	& Session	of Examination :					Name	& Des	ignatio	n of Fa	culty:											
			Q. No	1	2	3	4	5	6	7	8	9	10	11	12	13	14		STUD	ENT'S C	O Attair	nment
S.NO	REG NO	NAME OF THE STUDENT	CO	CO2	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO3	CO3	CO2	CO2	CO3	CO3	Total	CO2	CO2	CO3	CO3
			BT	R	R	U	R	R	R	R	R	R	R	Α	A	A	A			Attain		Attain
			Mark	2	2	2	2	2	2	2	2	2	2	10	10	10	10	_	30	ment	30	ment
1	17TC1102	ABINAYA.L		2	2	2	2	2	2	2	2	2	2	10	10		10	50	30	1	20	1
2	17TC1103	AISHWARYA.P		2	2	2	2	2	2	2	2	2	0	7	8		8	41	25	1	16	1
3	17TC1107	ANUSHA.S		2	2	2	2	2	2	2	2	2	2		9	10	9	48	19	1	29	1
4	17TC1108	ARAVINDH. P		2	2	2	2	2	2	2	1	2	2	5		5	6	35	15	1	20	1
5	17TC1109	ARIVAZAGI. S		2	2	2	2	2	2	2	1	1	1	3	0	0		20	13	0	7	0
6	17TC1110	ARUN.S		2	2	2	2	2	2	2	2	2	2	7	0		7	34	17	1	17	1
7	17TC1112	BALAJI.T		2	2	2	2	2	2	2	2	1	1	3	3	3	0	27	16	1	11	0
8	17TC1114	BAVADHARANI.P		2	2	2	2	2	2	2	2	2	2	5	9		9	43	24	1	19	1
9	17TC1115	BHARATH. R		2	2	2	2	2	2	2	0	2	2	7	0	8	9	42	17	1	25	1
10	17TC1117	BUVANESWARI, R		2	2	2	2	2	2	2	2	2	2	5	10	10		45	25	1	20	1
55	17TC1213	VIJAYANANDHINI.C]	2	2	2	2	2	1	1	1	1	1	7		8	8	38	17	1	21	1
56	17TC1216	VISHNUKUMAR.N	1	2	2	2	2	2	2	2	1	2	1	4	5	5	0	32	19	1	13	0
57	17TC1218	YAZHINI.G S	1	1	1	1	1	1	1	1	1	1	1	5	10		10	35	20	1	15	1
58	17TC1007	BHUVANESHWARLP	1	2	2	2	2	2	2	2	2	2	2	9		9		38	19	1	19	1
59	17TB2443	VIJAY BALAJI.R	1	2	2	2	2	2	2	2	2	2	2	10	10	5	0	45	30	1	15	1
	NO O	F STUDENTS ≥ 50% MARKS		57	57	56	57	56	57	57	56	57	55	33	35	33	31		Total		Total	
	NO	OF STUDENTS ATTEMPTED		59	59	59	59	59	59	59	59	59	59	43	46	43	42		students attained in	50	students attained in	41
	%		96.61	96.61	94.92	96.61	94.92	96.61	96.61	94.92	96.61	93.22	76.74	76.09	76.74	73.81		CO2		CO3		
		CO2	90.36																			
		CO3	89.79																			

Man	akula Vin	ayagar Institute of Tech	Level								Ue	escript	ion																				
Depa	rtment of El	lectronics and communication	or	1			65% and above but less than 70% of students scoring 50% marks in the relevant CO																										
Mode	Assessme	Int		2				70% a	and abo	ove bu	it less t	han 75	5% of s	tuden	ts scor	ing 50:	% mark	:s in th	e relev	ant CC)												
Yearl	Semester/S	Sec:		3					Mo	re thar	n 75%	of stuc	lents s	coring	50% п	narks ir	n the re	levani	t CO														
Subje	ect Name/C	iode:																															
Date	& Session o	of Examination :				Name	e & Des	signati	on of F	aculty	:																						
		Q. N	o 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Tot				STUEN	TSCC	ATTA	INMEN	л		
SNO	BEGNO	AME OF THE STUDEN	CO1	CO1	CO2	CO2	CO3	CO3	CO4	CO4	CO5	CO5	CO1	CO1	CO2	CO2	CO3	CO3	CO4	CO4	CO5	CO5	al	CO1	CO1	CO2	CO2	CO3	CO3	CO4	CO4	CO5	CO5
0.110	1.120110	BT	R	U	U	U	R	R	R	U	R	U	R	U	U	U	U	U	U	U	U	U	75		Attai		Attai		Attai		Attai		Attai
		Mar	k 2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	11	11	11	11		26	nme	26	nme	26	nme	26	nme	26	nme
1	17TC1102	ABINAYA L	2	2	2	2	1	1	1	1	1	1		7		10		8		8		10	57	11	1	14	1	10	1	10	1	12	1
2	17TC1103	AISHWARYA.P	2	2	1	2	2	2	2	2	2	2	9			9			8		9		54	13	1	12	1	4	0	12	1	13	1
3	17TC1107	ANUSHA.S	2	2	1	2	2	2	2	2	2	2	6		8		9		7		8		57	10	1	11	1	13	1	11	1	12	1
4	17TC1108	ARAVINDH . P	2	2	2	2	2	2	2	2	2	2		7		8	8		8		8		59	11	1	12	1	12	1	12	1	12	1
5	17TC1109	ARIVAZAGI. S	1	1	1	2	2	2	2	2	2	2	8		8			8		8		8	57	10	1	11	1	12	1	12	1	12	1
6	17TC1110	ARUN.S	1	1	2	2	1	2	2	2	2	2	6		8		8		7			8	54	8	1	12	1	11	1	11	1	12	1
7	177 C1112	BALAJI.T	2	2	2	2	2	2	2	2	2	2		8		8		8		9		9	62	12	1	12	1	12	1	13	1	13	1
8	17TC1114	BAVADHARANI, P	2	2	2	2	2	2	2	2	2	2		9		9		9	9		9	-	65	13	1	13	1	13	1	13	1	13	1
9	17TC1115	BHARATH R	2	2	1	2	2	2	2	2	2	2		9		9	4		4		5		50	13	1	12	1	8	1	8	1	9	1
10	17TC1117	BLIVANESWADI D	2	2	1	2	2	2	2	2	2	2	8	Ť	8	Ť	-	9	<u> </u>	8	8		60	12	1	11	1	13	1	12	1	12	1
51	17TC1202	THAMADALA	2	2	2	2	2	2	0	2	2	2	ň	8	- ×		9		8	Ŭ	8		59	12	1	12	1	13	1	10	1	12	1
52	17TC1208		2	2	2	2	2	2	2	2	1	2	8	-	- v		ă		- ă		9		62	12	1	12	1	13	1	13	1	12	1
53	17TC1203		1	1	1	2	0	1	1	1	1	1		5		đ	0		5		0	5	29	7	0	7	0	1	0	7		7	
55	17TC1210	VENKATESHWARAN.P	2	1		2	2	0	2	-	2	2		5		4	0		5		0	3	42	10	1		1	2	0	-	1	12	1
54	17TC1213	VIDTA SAGAR .S.P	2	2		2	2	0	2	2	2	2	<u> </u>			0			5		°		42	10	1	3	1	2	0	3		12	-
- 55	17TC1216	VIJATANANDHINI.C	2	2		2	2	2	2	2	2	2	3		- °		5			0	0		51	10	1	11	1	3	1	12	-	12	1
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58	11101001	DHOVANCONWARLP	2	2	1	2	2	2	2	2	2	2	6		6		6		5			6	48	10	1	9	1	10	1	9	1	10	1
59	1116244	VIJAT DALAJI.R	2	Z	1	2	2	2	Z	1	1	1	в		8		Э			Э	6		57	13	1	11	1	13	1	12	1	8	1
	NO OF STU	UDENTS≥50% MARKS	55	56	57	57	57	56	57	58	57	56	23	35	24	32	36	17	39	10	36	20		Total		Tatal		Tatal		Tatal		Tatal	
	NO OF	STUDENTS ATTEMPTED	59	59	59	59	59	59	59	59	59	58	24	35	24	34	38	17	42	10	38	20		r attaino din	54	r attaine din	53	/ attaino din	48	attaino din	45	s attaine din	50
	% ST	UDNETS≥50% MARKS	93.2	94.9	96.6	96.6	96.6	94.9	96.6	98.3	96.6	96.6	95.8	100	100	94.1	94.7	100	92.9	100	94.7	100		CO1		CO2		CO3		CO4		COS	
		AVERAGE OF CO1	96																														
		AVERAGE OF CO2	96.8																														
		AVERAGE OF CO3	96.6																														
		AVERAGE OF CO4	96.9																														
		AVERAGE OF CO5	97																														

со	A INT1	B INT 2	C MODEL	AVER AGE of A,B& C	ATTAIN MENT LEVEL	UNIVER EXAM	ATTAIN MENT LELEVL	D INT 20%	E UE 80%	F Direct attainm ent =D+E TOTAL CO	G Indirect attainment COURSE EXIT SURVEY	OVERALL CO ATTAINMENT 90% F+10% G
CO1	77.9		96.0	87.0	3	100	3	0.6	2.4	3	2.09	2.91
CO2		90.356	96.8	93.6	3	100	3	0.6	2.4	3	2.09	2.91
CO3		89.789	96.6	93.2	3	100	3	0.6	2.4	3	2.18	2.92
CO4			96.9	96.9	3	100	3	0.6	2.4	3	2.06	2.91
CO5			97.0	97.0	3	100	3	0.6	2.4	3	2	2.90

Computation of CO Attainment for the Course

Course Exit Survey

Please rate each of the following skills, abilities or attributes in terms of their importance, and state how well your understanding about the course

Please rate each of the following skills, abilities or attributes in terms of their importance, and state how well your understanding about the course

- 1 Not Attained (Not satisfied)
- 2- Low attainment (Understood the CO, but skills need to be improved)
- 3 Moderate (Satisfied in the attainment level of the CO)
- 4 Above Moderate (Fair in the attainment level of the CO)
- 5 -High (Strong in the CO, acquired the skills in the specified cognitive level)

Evaluation OF CO						
Scale: 1- strongly DISAGREE; 2 – Disag Please prov	gree; ide feed	3 – n back ir	eutral; • the co	4 – mments	agree; box	5 – strongly agree
	1	2	3	4	5	Comments
1. Are you able to (CO1 for the subject)						
2. Are you able to (CO2 for the subject)						
3. Are you able to (CO3 for the subject)						
4. Are you able to (CO4 for the subject)						
5. Are you able to (CO5 for the subject)						

PSO 2

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Average

CO						Р	O					
tu	1	2	3	4	5	6	7	8	9	10	11	12
1	3	-	-	-	-	-	-	-	-	-	-	-
2	-	2	1	_	-	-	-	-	-	-	-	-

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Let us assume CO-PO mapping of a course

Overall Attainment of CO is as below

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СО	Direct Tool Attainment (A)	Indirect Tool Attainment (B)	Overall CO Attainment = 0.8 * A + 0.2 * B
1	2	3	2.8
2	3	3	3
3	2	3	2.8
4	1	3	2.6

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

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

Sample calculations:

CO1- PO1 mapping attainment $2.8 \times 3/3 = 2.80$ (up to 2 decimal places)

- CO2- PO2 mapping attainment $3 \ge 2/3 = 2.00$
- CO2- PO3 mapping attainment $3 \times 1/3 = 1.00$
- CO3- PO3 mapping attainment $2.8 \times 1/3 = 0.93$
- CO4- PO12 mapping attainment $2.6 \ge 1/3 = 0.86$



Improvements in Attainments of CO and PO

High Attainment of CO and PO		Increase Target value
Moderate Attainment of CO and PO	' t	Target is not changed. Conduct more activi- ties to attain the fixed Target
Low Attainment of CO and PO	1	Consider reducing the Target and analyze methodologies to attain the Targets.
No Attainment of CO and PO	(Reduce Target and review the entire process of OBE to achieve the low level Attainments

Improvements for Non Technical Program Outcomes

Improvements can be done by

- Personalized learning
- Blended Learning Activities
- Competitions
- Extension activities
- Industrial Interaction
- Project based Learning
- Innovative Assignments
- ♦ Teaching Life skills



ANNEXURE 7/1/EX(1/) =

Bloom's Taxonomy Usage

Remembering

Suppose a question of following kind is put before the students,

Who was the Author of book My Experiments with Truth?

- (a) Jawaharlal Nehru
- (b) Mahatma Gandhi
- (c) Abraham Lincoln
- (d) Nelson Mandela

The answer to above question is obviously (b). To answer above question, one need knowledge and he/she should be able to recall that from his/her memory. Therefore, above question is of Bloom's Level 1, i.e Remembering. Other questions of this level can be set using the action verbs who, tell, define, recall, identify, name, when, where, list etc. The first level therefore is to test the ability of student to recall the information/knowledge he/she has gained during the course of study.

Understanding

Let us examine the following question now,

Which of the following is true aboutCOVID-19 pandemic?

(a) It happened due to high level of pollution.

- (b) It occurred in non-vegetarians only.
- (c) It happened due to a virus from animal.
- (d) It happened due to bacteria.

We know that the answer to above question is(c) but our purpose is to know how the candidate shall reach at the correct option. It is not a pure knowledge question because it requires the understanding of the concept as well. The candidate who has the understanding of viruses, bacteria etc., shall be able to answer above question, it means it tests the skill of understanding of the candidate. Therefore, it is a question of Bloom's Level 2. Another question of Level 2 can be like; "Explain the concept by which plants are able to generate oxygen during day time."Action verbs to set the questions of Level 2 can be describe, explain, summarise, interpret, discuss etc. which test the ability of student to translate knowledge to new context and understand the information.

Applying

Let us check the following question,

The Length of one side of a rectangular table is 3.0m and it's diagonal is 5.0m long. Applying Pythagoras theorem to find the area of table?

- (a) 15 meter square
- (b) 25meter square
- (c) 9 meter square
- (d) 12meter square

The correct answer to above question is (d) and the student can reach at correct option if he/she has ability to apply the concept of Pythagoras theorem to his/her knowledge about rectangles. Questions starting with verbs like apply, illustrate, solve, use, demonstrate, determine, modify, calculate, model etc. can be set for Bloom's Level 3. To answer the question of Level 3, the candidate has to apply the knowledge and understanding of the concept hidden inside the statement of the question. One more example of this level may be: "Write the steps to prevent an epidemic to spread in your country keeping in view the guide-lines issued by World Health Organization."

Analyzing

Fourth Bloom's Level is to test the ability of Analysis. It requires the skill to break down a problem into parts and then to find a relationship of the parts and the way the parts are organised.

Let us take the following question as an example of Level 4. The Table represents the relationship between annual income and number of children below 15 years of age of select families of a locality.

Sl. No	Annual Income of family	No of Children with age less than15 Years
1	Less than Rs 100,000	320
2	Rs 100,00 to Rs 500,000	200
3	Rs 500,000 to Rs 700,000	15
4	Rs 700,000 to Rs 1000,000	80
5	Above Rs 1000,000	20

From the Table, one can conclude that the families with lower income have more children. The examiner's question is which of the following assumptions would be correct to justify the conclusion?

(a) All families are able to send their children to expensive schools.

(b) The families with lower income group need fee concession for better education of their wards.

(c) The families with higher income are supporting the families in lower income group.

(d) Children belonging to the families of higher income are more intelligent than other families.

This question tests one's ability to have knowledge of value of currency, understanding of fee structure of schools and analysis of the data. Based on these abilities he/she shall tick option (b) as correct answer.

Evaluating

To achieve this level the candidate has to demonstrate the skill to compare between different ideas, make choices based on logical arguments and to make judgement by using some criteria. The action verbs for the problems to examine the student for this level may be measure, recommend, conclude, justify, assess, choose, compare, summarise, evaluate etc.

An example to clarify more is given below. A factory building work was going on smoothly with 100 workers which include 3 supervisors, one architect, 20 skilled labourers and other unskilled manpower, with this manpower the work was to finish in 45 days. The work stopped due to lockdown of the country and 70% of skilled and unskilled labourers left the job. Assess the delay in 01204356699 projects and recommend a comprehensive plan to finish the job in 90 days after opening of the lockdown with the manpower present on site. The roles of each worker are already defined..

Creating

This level is to examine the ability to create new idea using the existing concepts or to draw conclusions from a complex problem. The action verbs used to examine this skill are design, generate, develop, create, formulate, invent, compose, integrate etc. Following example is given in this reference:

In an online examination the web camera is used to monitor the candidates during examination but still some candidates cheat the examination. Develop a system using biometric credentials of candidates so that cheating can be curbed to minimum level including cheating in the form of impersonation.

Program Outcomes- Competencies-Performance Indicators.

PO1: Engineering Knowledge: apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

Competency			Performance Indicators		
1.1	Demonstrate competence in mathe-	1.1.1	Apply mathematical techniques such as linear algebra, differential calculus, differential equa- tions and integral calculus to solve problems		
	matical modeling	1.1.2	Apply concepts of Complex Variable, proba- bility, linear algebra, vector integration and transformation techniques to model and solve electronics engineering problems.		
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem		
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply engineering fundamentals		
1.4	Demonstrate competence in spe- cialized engineering knowledge to the program	1.4.1	Apply electronics engineering concepts to solve engineering problems		

PO2: Problem Analysis: identify, formulate, review research literature, and analyze complex engi-

neering problems reaching substantiated conclusions using first principles of mathematics,

natural sciences, and engineering sciences.

Competen-			Performance Indicators
cy			
	Demonstrate an ability to identify and formulate complex engineer- ing problem	2.1.1	Articulate problem statements and identify objectives.
2.1		2.1.2	Identify engineering systems, variables, and parameters to solve a problem
		2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2	Demonstrate an ability to for- mulate a solution plan and meth- odology for an engineering problem	2.2.1	Reframe complex problems into interconnected sub-problems.
		2.2.2	Identify, assemble and evaluate information and resources
		2.2.3	Identify existing solution/methods for solving the problem, including forming justified approximations and assumptions
		2.2.4	Compare and contrast alternative solution/methods to select the best methods.

2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is ap- propriate in terms of applicability and required accuracy.
		2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
	Demonstrate an ability to execute a solution process and analyze results	2.4.1	Apply engineering mathematics to implement solution
2.4		2.4.2	Analyze and interpret the results using contemporary tools.
		2.4.3	Identify the limitations of the solution and sources/causes of error.
		2.4.4	Arrive at conclusions with respect to the objectives.

PO3: 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.

Competency			Performance Indicators
		3.1.1	Recognize that need analysis is key to good problem definition
		3.1.2	Able to identify and document system requirements from stakeholders.
		3.1.3	Ability to review state of the art literature to synthesize requirements.
3.1	Demonstrate an ability to define a complex/open-ended problem in engineering terms	3.1.4	Extract engineering requirements from rel- evant engineering codes and standards defined by ISO/IEC/IEEE.
		3.1.5	Explore and synthesize engineering require- ments considering health, safety, risks, environment, cultural and societal issues
		3.1.6	Determine design, objectives, functional requirements and arrive at specifications
		3.2.1	Ability to explore design alternatives.
3.2	Demonstrate an ability to generate a diverse set of al- ternative design solutions	3.2.2	Build models/prototypes to develop diverse set of design solutions
		3.2.3	Identify suitable criteria for evaluation of alternate design solutions
3.3	Demonstrate an ability to select opti- mal design scheme for further development	3.3.1	Ability to perform systematic evaluation of the degree to which several design concepts meet the criteria.

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

PO4: Conduct Investigation of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

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

PO5: Modern Tools 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.

	Competency		Performance Indicators
5.1	Demonstrate an ability to identify/ create modern engineering tools,	5.1.1	Identify modern engineering tools techniques and resources for engineering activities
	techniques and resources	5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information (ii) mod- eling and simulating (iii) monitoring system performance, and (iv) creating engineering designs
		5.2.2	Demonstrate proficiency in using discipline specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO6: The Engineer and Society: apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

	Competency		Performance Indicators
6.1	Demonstrate an ability to describe engineering roles in a broader con- text, e.g. pertaining to the environ- ment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level.
6.2	Demonstrate an understanding of professional engineering regula- tions, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to professional engineering practice and explain its contribution to the protection of the public.

PO7: Environment & Sustainability: understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Competency		Performance Indicators	
	Demonstrate an understanding of the impact of engineering and in-	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
7.1	dustrial practices on social, envi- ronmental and in economic contexts	7.1.2	Understand the relationship between the technical, socioeconomic and environmental dimensions of sustainability

Competency			Performance Indicators	
PO8: Ethics: apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.				
7.2	principles of sustainable design and development	7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline	
	Demonstrate an ability to apply	7.2.1	Describe management techniques for sustainable development	

8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives	
8.2	Demonstrate an ability to apply the	8.2.1	Identify tenets of code of ethics given by the professional bodies like IEEE.	
	code of ethics	8.2.2	Examine and apply moral & ethical principles to known case studies	

PO9: Individual & Team work: function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency		Performance Indicators		
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team	
		9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas etc.) of effective team work, to accomplish a goal	
	Demonstrate effective individual	9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills	
9.2	cation, problem solving, conflict	9.2.2	Treat other team members respectfully	
	resolution and leadership skills	9.2.3	Listen to other members	
		9.2.4	Maintain composure in difficult situations	
9.3	Demonstrate success in a team based project	9.3.1	Present results as a team, with smooth integra- tion of contributions from all individual efforts	

PO10: 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.

Competency		Performance Indicators	
10.1	Demonstrate an ability to compre-	10.1.1	Read, understand and interpret technical and non-technical information
	ment project work	10.1.2	Produce clear, well-constructed, and well- supported written engineering documents

		10.1.3	Create flow in a document or presentation- a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listen-	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others Deliver effective oral presentations to technical and nontechnical audiences
	ing, speaking and presentation	10.2.2	Deliver effective oral presentations to technical and nontechnical audiences
10.3	Demonstrate the ability to in- tegrate different modes of	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
	communication	10.3.2	Use a variety of media effectively to convey a message in a document or a presentation

PO11: Project management & 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.

Competency		Performance Indicators		
11.1	Demonstrate an ability to evaluate the economic and financial perfor- mance of an engineering activity	11.1.1	Describe various economic and financial costs/benefits of an engineering activity	
		11.1.2	Analyze different forms of financial state- ments to evaluate the financial status of an engineering project	
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate pro- posals for an engineering activity	11.2.1	Analyze and select the most appropriate pro- posal based on economic and financial consid- erations	
11.3	Demonstrate an ability to plan/ manage an engineering activity	11.3.1	Identify the tasks required to complete an engineering activity and the resources required to complete the tasks	
	within time and budget con- straints	11.3.2	Use project management tools to schedule an engineering project so it is completed on time and on budget	

PO12: 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.

Competency		Performance Indicators		
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	Describe the rationale for requirement for continuing professional development	
		12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap	
12.2		12.2.1	Identify historic points of technological advance in engineering that required	

			practitioners to seek education in order to stay current
	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.
12.3	Demonstrate an ability to identify	12.3.1	field. Source and comprehend technical literature and other credible sources of information
	information	12.32	Analyze sourced technical and popular in- formation for feasibility, viability, sustainability etc.

Program Specific Outcomes- Competencies-Performance Indicators. (ECE Sample)

PSO1: Products Development: Use modern tools to design subsystems for simple applications in Embedded Systems and VLSI.				
13.1	Ability to develop small prototypes of Embedded Systems	13.1.1	Select and use suitable Embedded sys- tems and design prototypes	
		13.1.2	Develop a product with innovation	
13.2	Ability to simulate VLSI based systems	13.2.1	Simulate novel circuits using modern tools	
		13.2.2	Analyze the developed VLSI based cir- cuits for application in niche areas.	
		13.2.3	Evaluate the simulation through FPGA Hardware and apply for real time sys-	
PSO1: Design Thinking: Apply engineering concepts to find solutions in the fields of Communications, Signal/Image Processing.				
14.1	Ability to design communication sys- tems	14.1.1	Simulate simple communication systems for wired and wireless application	
		14.1.2	Develop Protocols for networking and communication systems	



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