

USHA RAMA

COLLEGE OF ENGINEERING AND TECHNOLOGY

On NH16, Telaprolu, Near Gannavaram, Krishna Dist. – 521109

Ph.: 0866-2527558, www.usharama.edu.in

(An Autonomous Institute, Approved by AICTE, New Delhi, Permanently Affiliated to JNTUK, Kakinada)

DEPARTMENT OF MECHANICAL ENGINEERING

OUTCOME BASED EDUCATION



B.TECH (ME) – UR20 REGULATION

USHARAMA

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INSTITUTE VISION AND MISSION

VISION:

To emerge as a **centre of excellence** in technical education by imparting **quality teaching learning practices** and **research for the transformation of society**

MISSION:

1. Provide an ideal and the best class infrastructure to foster exploration in engineering and research.
2. Build dedicated faculty with student centric teaching, incorporating experiential, innovative skills.
3. Encourage life-long learning, entrepreneurial thinking, and ethical responsibility in students to address societal challenges.
4. Imbibe values and encourage in activities for over-all personality development of the students.

DEPARTMENT VISION AND MISSION

VISION:

To impart quality education in the field of Mechanical Engineering to meet the industrial standards and technological needs of the society.

MISSION:

M1: To provide quality education for career building and skill enhancement and to become globally competitive.

M2: To groom the students with leadership qualities, problem solving approach, along with team work and effective communication.

M3: To promote higher education, entrepreneurship skills, research cum innovation with a focus on industrial and societal needs and to mould the students with professional ethics and moral values.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

The graduates of the programme are able to

PEO 1: To train the graduates in building a successful professional career in Mechanical Engineering.

PEO 2: To encourage the graduate engineers to achieve their goals through higher education and Research & Development activities.

PEO 3: To support the graduates to become moral & ethically responsible citizens in the development of the nation.

PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and the World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and

design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Apply Engineering fundamental knowledge, complex mathematics, science and provide solutions to mechanical Engineering system.

PSO2: Design and develop products innovatively with modern tools and to optimize manufacturing processes.

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DEPARTMENT OF MECHANICAL ENGINEERING

This Manual is a reference to help faculty, staff and stakeholders to understand the Outcome Based Education (OBE) system implemented at Usha Rama College of Engineering and Technology. The manual serves as valuable guidelines for the faculty to develop an assessment plan in the process to measure the outcome of the students during their course of study and also after their graduation. The manual outlines the process involved in developing a constructive curriculum development and content delivery or teaching plan.

OUTCOME BASED EDUCATION (OBE)

Outcome-Based Education (OBE) model is being adopted at a fast pace at Engineering colleges in India at the moment. It is considered as a giant leap forward to improve technical education in India and help Indian Engineers compete with their global counterparts. Outcome Based Education (OBE) is an important demonstration Tool for student-centered instruction that focuses on measuring student performance through outcomes.

Quality assurance and improvement process is about determining whether the set educational objectives meet a general standard of quality. Emphasis of outcome-based education (OBE) system is on quantifying what the students are capable of doing and learning outcomes of the students is one of the key components. Course Outcomes are the statements indicating knowledge and skills the student is expected to acquire at the end of a course. Program outcomes represent the knowledge, skills and attitudes the students should have at the end of program. Program outcomes can be directly measured through course outcomes. The outcome-based education model is based on defining various parameters called as Graduates Attributes (POs).

ABBREVIATIONS:

OBE	Outcome Based Education	BTL	Bloom's Taxonomy Level
LOT	Lower Order of Thinking	HOT	Higher Order of Thinking
PEO	Program Educational Objectives	PO	Program Outcome
CO	Course Outcome	PSO	Program Specific Outcome
CE	Course Exit Survey	HoD	Head of Department
PC	Program Coordinator	DAC	Department Advisory Committee
PAC	Program Assessment Committee	AY	Academic Year

OBE enhances the traditional methods and focuses on what the Institute provides to students. It shows the success by making or demonstrating outcomes using statements "able to do" in favour of students. OBE provides clear standards for observable and measurable outcomes.

Accreditation Serves to Notify:

- Parents and prospective students that a program has met minimum standards.
- Faculty, HOD, Principal of a program's strengths and weaknesses and of ways to improve the programme.
- Employers that graduates are prepared to begin professional practice
- The public that graduates are aware of societal considerations.

Purpose of accreditation is NOT TO:

- Find faults with the institution but to assess the status-ante of the performance.
- Denigrate the working style of the institution and its programs but to provide a feedback on their strengths and weaknesses.
- Demarcate the boundaries of quality but to offer a sensitizing process for continuous improvement in quality provisions.
- Select only institutions of national excellence but to provide benchmarks of excellence and identification of good practices.

Benefits of Accreditation:

- Facilitates continuous Quality Improvement.
- Demonstrates accountability to the public.
- Improves staff morale.
- Recognizes the achievements/innovations.
- Facilitates information sharing.
- Priority in getting financial assistance helps the Institution to know its strengths, weaknesses and opportunities.

- Initiates Institutions into innovative and modern methods of pedagogy
- Promotes intra and inter-Institutional interactions

Pre 2013 Scenario:

- Educational quality measurements focused on inputs, activities and outputs, such as resources used, classes taught, articles published, placements and graduate enrolments
- Such performance indicators provide no measurement of the degree to which Institutions of higher learning actually develop the knowledge and skills of their students.
- These measurements are ill-suited to inform governments, students and the general public about teaching and learning quality
- In the absence of comparable learning outcomes assessment across institutions, ratings and rankings are widely used as proxies for relative educational quality.
- NBA criteria were mainly input-process-output related and there were no direct measures of quality of learning.

WASHINGTON ACCORD:

It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering.

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

What are Outcomes?

- An outcome of an education is what the student should be able to do at the end of a program/ course/ instructional unit.
- Outcome-based education is an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the program/ course.

- Outcomes are the abilities the students acquire at the end of the program
- In outcome-based education, "product defines process".
- It is the results-oriented thinking and is the opposite of input-based education where the emphasis is on the educational process and where we are happy to accept whatever is the result.
- Outcome-based education is not simply producing outcomes for an existing curriculum.

A learning outcomes answers the question: "What is it that your students should be able to do at the end of the hour/lecture that they could not do before?". It provides a clear guidance for the planning and development of the teaching process, including the design and organization of materials, the selection of the most appropriate teaching methods, as well as providing a measure for quality assurance (Biggs, 2003).

Some important aspects of the Outcome Based Education:

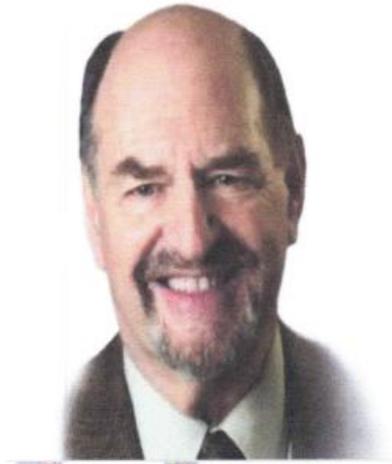
1. **Course** is defined as a theory, practical or theory cum practical subject studied in a semester. For example Engineering Mathematics
2. **Course Outcome (CO)** Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.
3. **Program** is defined as the specialization or discipline of a Degree. It is the interconnected arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. For Example: B.E., Marine Engineering.
4. **Program Outcomes (POs)** Program outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.
5. **Program Educational Objectives (PEOs)** The Program Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.
6. **Program Specific Outcomes (PSO)** Program Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline. Usually there are two to four PSOs for a program.

All OBE approaches take a criterion-based view of assessment and focus on what students can do with knowledge after a period of learning

LEVELS OF OUTCOMES:

- **Program Educational Objectives:** PEOs are broad statements that describe the career and professional accomplishments in five years after graduation that the program is preparing graduates to achieve.
- **Program Specific Outcomes:** PSOs are statements that describe what the graduates of a specific engineering program should be able to do.
- **Program Outcomes:** POs are statements that describe what the students graduating from engineering programs should be able to do.
- **Course Outcomes:** COs are statements that describe what students should be able to do at the end of a course. The method of assessment of the candidates during the program is left for the institution to decide. The various assessment tools for measuring Course Outcomes include Mid -Semester and End Semester Examinations, Tutorials, Assignments, Project work, Labs, Presentations, Employer/Alumni Feedback etc...

FOUR PRINCIPLES IN OBE:



Dr. William Spady is considered as the father of OBE.

The most widely used one is the four principles suggested by Dr. William Spady in the year 1994.

CLARITY OF FOCUS:

Clarity of focus, meaning that all activities (teaching, assessment, etc) are geared towards what we want students to demonstrate;

DESIGNING DOWN:

Design down, meaning designing the curriculum from the point at which you want students to end up.

HIGH EXPECTATIONS:

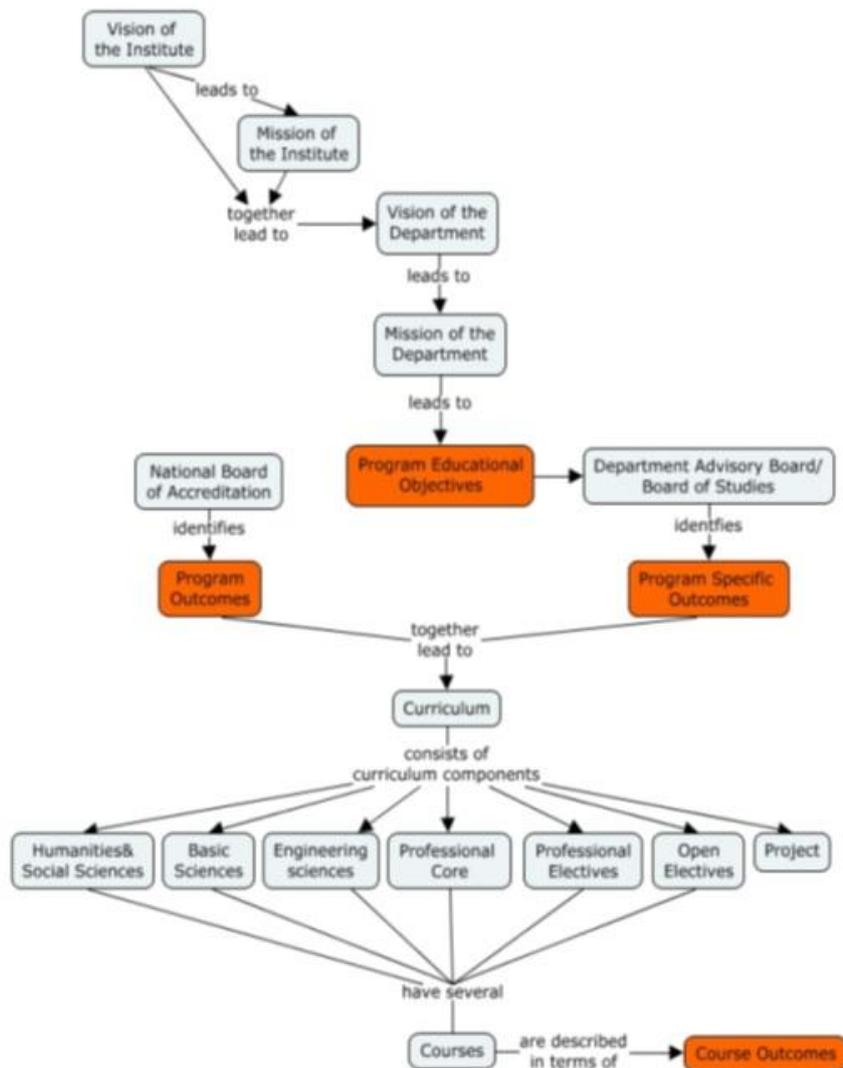
- Establish high, challenging performance standards.
- Engage deeply with issues are learning.

EXPANDED OPPORTUNITES:

- All students can be successful. Its only that they may require different instructional strategies.
- Additional learning opportunities in order to do so.

THE ESSENTIALS OF OBE:

- In OBE, what matters ultimately is not what is taught, but what is learned.
- Teachers must set appropriate course intended learning outcomes, instead of teaching objectives.
- Constructive alignment: What we teach, how we teach and how we assess ought to be aligned with the intended learning outcomes, such that they are fully consistent with each other.
- The quality of teaching is to be judged by the quality of learning that takes place;



Outcomes and Objectives in NBA framework

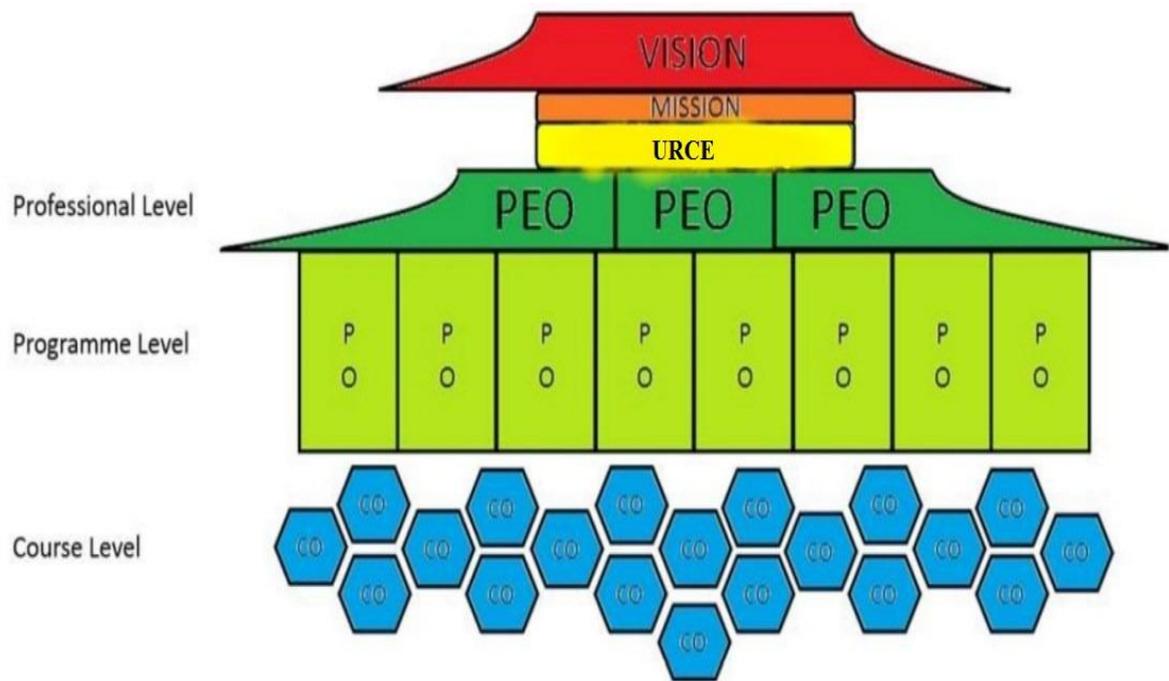
PROGRAM OUTCOME (PO) are descriptions of the qualities, skills, abilities and understandings, an institutional community agrees that its students should develop as a consequence of the learning they engage with the program of study in that institution. POs indicate what students are expected to know and be able to do by the time they graduate from the institution. POs are not directly connected to any specific academic disciplines.

Students join an institution from different backgrounds, cultures and experiences. While studying at the institution, we want them to broaden their horizon and attitudes, and to develop their current skills and abilities and learn new ones. This is expected not only to help them in their studies and future careers, but also to support their role within society. POs also reflect the Vision, Mission and Core Values of the institution.

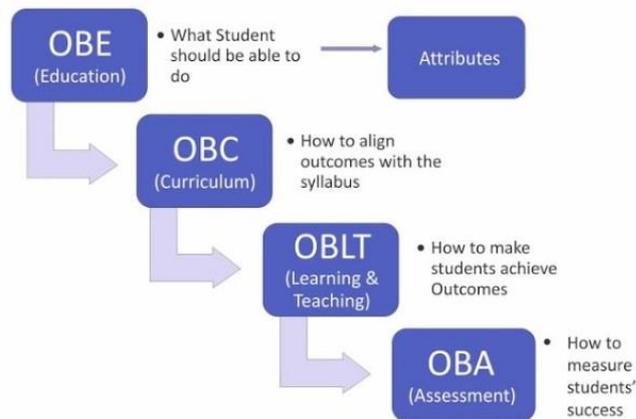
POs are not simply taught but developed through meaningful experiences and the processes of learning and reflection. They are unique to every student, yet might be able to identify some common areas that the institution wants their students to develop. Students will have their own starting points, progress and experiences in these areas while at the institution which will shape them as individuals.

1. Engineering Knowledge
2. Problem Analysis
3. Design and Development of Solutions
4. Conduct Investigations on Complex Problems
5. Engineering Tool Usage
6. The Engineer and the World
7. Ethics
8. Individual and Collaborative Team Work
9. Communication
10. Project Management and Finance
11. Life-Long Learning

PROGRAM SPECIFIC OUTCOME: PSOs are statements that describe what the graduates of a specific engineering program should be able to do

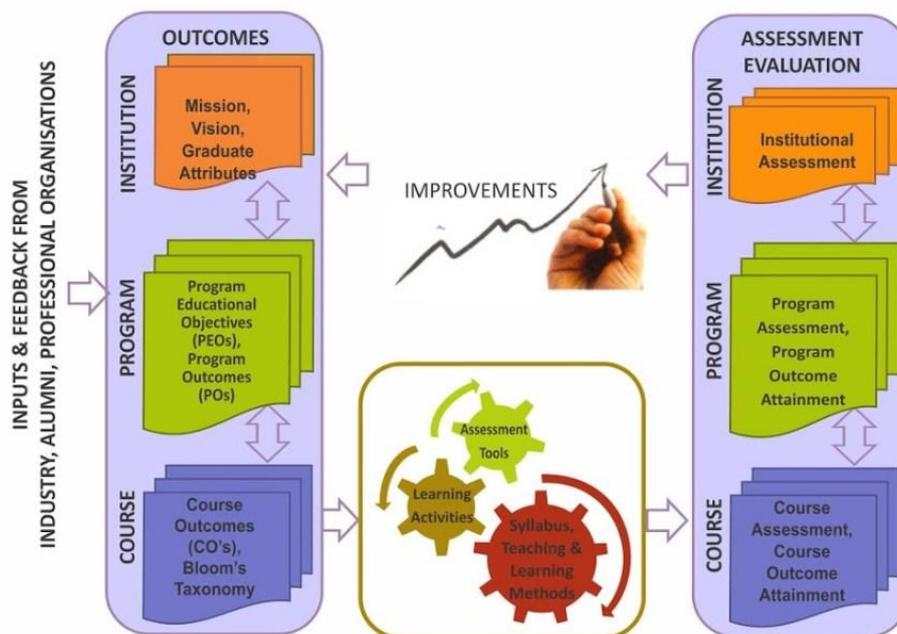


Outcome Based Accreditation



Reference : NBA India- Learning Resources

OBE Framework



TRADITIONAL VS THE OUTCOME-BASED APPROACH:

The traditional way of teaching was where the teacher instructs the students and the students generally take down the notes without even logical thinking. The important thing regarding teaching in the traditional method is that topic is written on the blackboard and students take down notes from the blackboard as a result at the end of the day the students memorize the same and appear for the examination with the at most intention to pass the Examination. With the recent advancement, there is no point in adhering to the Traditional method as the competition towards has increased enormously.

Outcome based education is seen a paradigm shift in the higher education that is student focused and outcome orientated. The table below provides a comparison of the traditional teaching approach and the outcome-based approach.

Outcome-Based Approach	Traditional Teaching Approach
Learner/student-centered	Teacher-centered
Teacher's role as partner/facilitator	Teacher's role as instructor
Focus on learner's output	Focus on teacher's input
Flexible and empowering	Rigid and controlling
Emphasis on progress and overall learning	Emphasis on products
Learning outcomes/Learning programmes are seen as guides that allows teachers to be innovation and creative in achieving learning outcomes	Course objectives/Syllabus is seen rigid & non negotiable
Criterion-reference assessment	Norm-referenced assessment
Ability building and skills development	Content-based and content delivery

ADMINISTRATIVE SYSTEM FOR OBE:

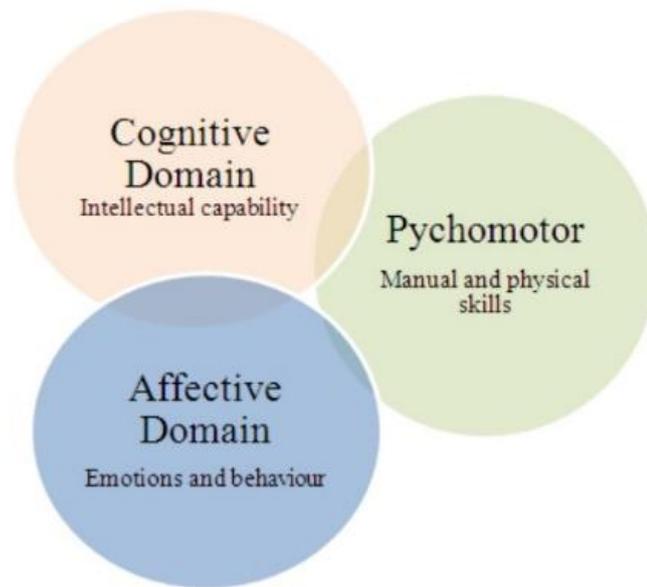
Administrative System for OBE



BLOOM'S TAXANOMY:

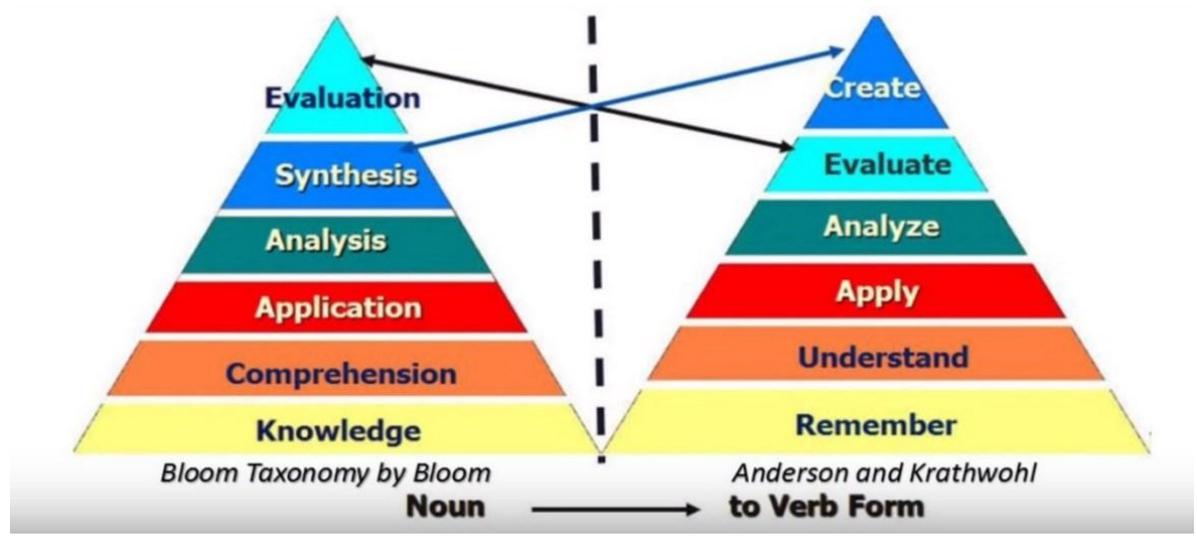
Bloom's Taxonomy provides an important framework to not only design curriculum and teaching methodologies but also to design appropriate examination questions belonging to various cognitive levels. Bloom's Taxonomy of Educational Objectives developed in 1956 by Benjamin Bloom was widely accepted by educators for curriculum design and assessment. In 2001, Anderson and Krathwohl modified Bloom's Taxonomy to make it relevant to the present-day requirements. It attempts to divide learning into three types of domains (cognitive, affective, and behavioural) and then defines the level of performance for each domain. Conscious efforts to map the curriculum and assessment to these levels can help the programs to aim for higher-level

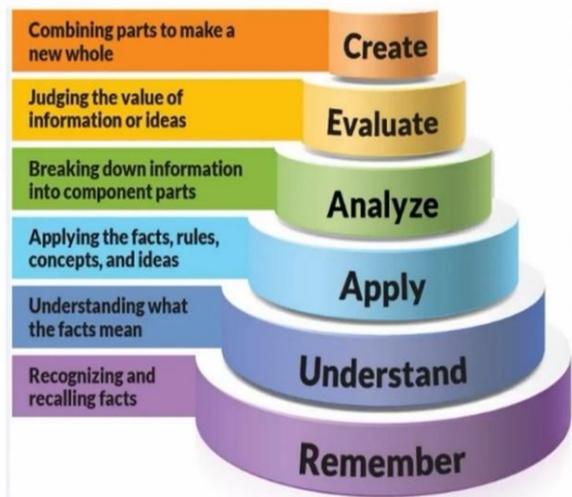
abilities which go beyond remembering or understanding, and require application, analysis, evaluation or creation. Revised Bloom's taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge. It is a popular framework in engineering education to structure the assessment as it characterizes complexity and higher-order abilities. It identifies six levels of competencies within the cognitive domain as shown below which are appropriate for the purposes of engineering educators.



Learning Domains

The blooms taxonomy is shown in figure where the lower levels become foundation for the higher levels. The Bloom's taxonomy process is ordered in such a way that the lowest level is the simplest form of recognition, while the highest level built on lower levels involves more complex form of cognitive skill. By providing a hierarchy of levels, this taxonomy can assist teachers in designing assessment framework to measure the student's learning ability and making teaching method, innovative and adaptive to student's competencies and enhancing the same.





- Developed to provide a common language for teachers to discuss and exchange learning and assessment methods.
- It is a hierarchical model used to classify educational learning objectives into levels of complexity and specificity

The cognitive process dimensions- categories					
Lower Order of Thinking (LOT)			Higher Order of Thinking (HOT)		
Remember	Understand	Apply	Analyse	Evaluate	Create
Recognizing (identifying)	Interpreting	Executing	Differentiating	Checking (coordinating, detecting, testing, monitoring)	Planning
Recalling (retrieving)	Illustrating	Implementing	Organizing	Critiquing (judging)	Generating
	Classifying		Attributing		Producing (constructing)
	Summarizing				
	Inferring (concluding)				
	Comparing				
	Explaining				

COURSE OUTCOME ASSESSMENT PROCESS

The Key aspects in Outcome-Based Education (OBE) are the assessment of Course Outcomes. At the initial stage of OBE implementation, the Course Outcomes (COs) for each course are defined based on the Program Outcomes (POs) and other requirements. At the end of each course, the COs need to be assessed and evaluated to check whether they have been attained or not.

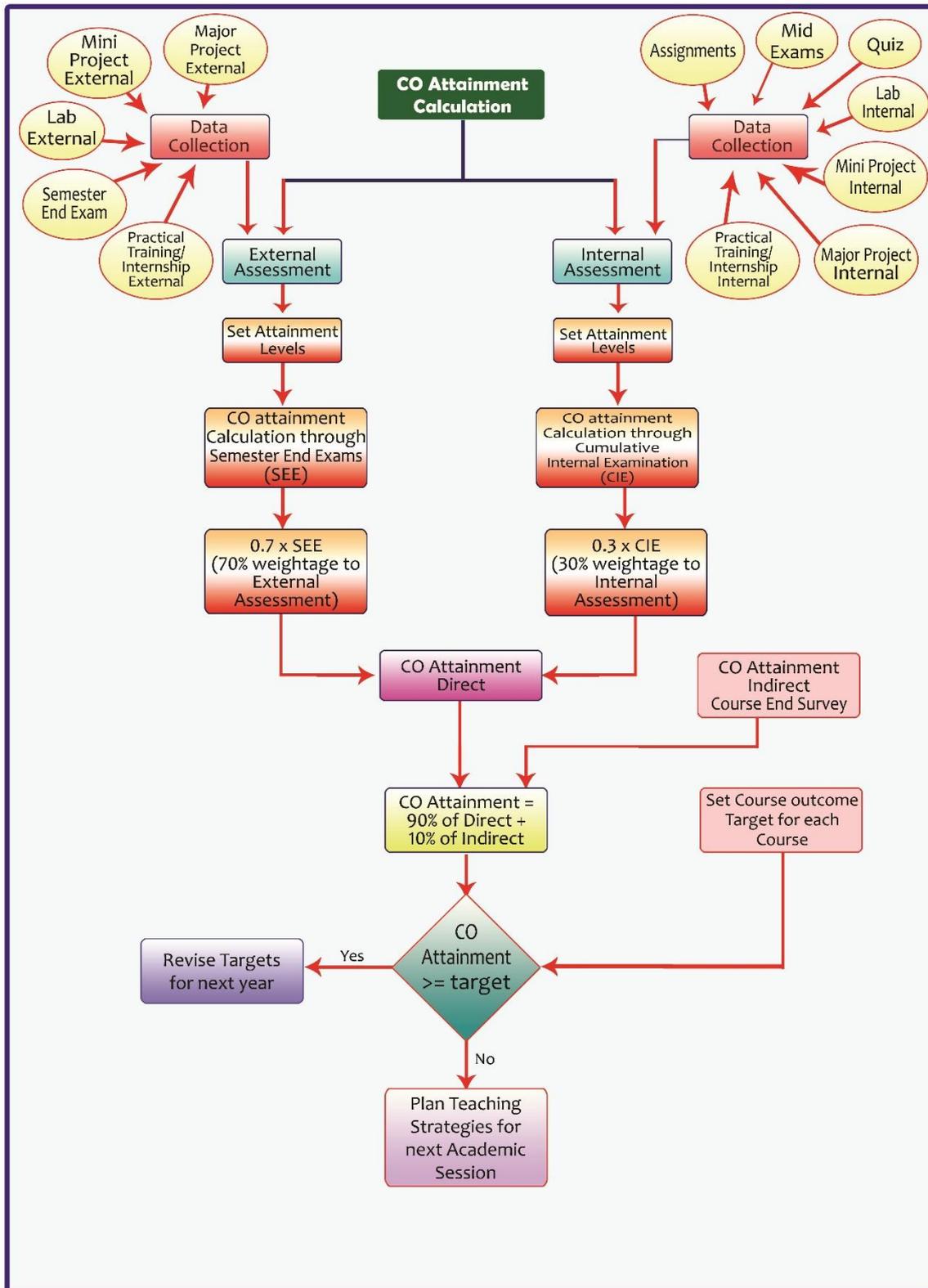
The process of attainment of COs, POs and PSOs starts from writing appropriate COs for each course of the program from first year to fourth year in a four-year engineering degree program. The course outcomes are written by the respective faculty member using action verbs of learning levels suggested by Bloom and Anderson. Then, a correlation is established between COs and POs in the scale of 1 to 3, 1 being the slight (low), 2 being moderate (medium) and 3 being substantial (high). A mapping matrix is prepared in this regard for every course in the program including the elective subjects. The course outcomes written and their mapping with POs are reviewed frequently by a committee of senior faculty members before they are finalized.

Assessment is one or more processes carried out by the department, which identify, collect and prepare data to evaluate the achievement of POs and Program Specific Outcomes (PSOs). Attainment is the action or fact of achieving a standard result towards accomplishment of desired goals. Primarily attainment is the standard of academic attainment as observed by examination results.

Course Outcomes (COs): Statements indicating what a student can do after the successful completion of a course. Every Course leads to some Course Outcomes. The CO statements are defined by considering the course content covered in each module of a course. For every course there may be 5 or 6 COs. The keywords used to define COs are based on Bloom's Taxonomy

Attainment of the COs can be measured directly and indirectly. Direct attainment displays the student's knowledge and skills from their performance. It can be determined from the performance of the students in all the relevant assessment instruments like internal assessments, assignments, quiz and final examinations. These methods provide a sampling of what students know and/or can do and provide strong evidence of student learning.

Indirect methods such as Course End Surveys ask the students to reflect on their learning. They access opinions or thoughts about the graduate's knowledge or skills. Indirect measures can provide information about graduate's perception of their learning and how this learning is valued by different stakeholders. The entire assessment process is depicted in the following Figure.



CO ATTAINMENT CALCULATION PROCESS

CO ATTAINMENT CALCULATION PROCESS:

For the evaluation and assessment of CO's and PO's, rubrics are used. Course Outcome is evaluated based on the performance of students in internal assessments and in End examination of a course. Internal assessment contributes 30% and End examinations assessment contributes 70% to the total attainment of a CO. After measuring CO attainment for a course, CO-PO mapping table will give Program Outcome attainment levels. The Program outcomes (PO's) are defined by NBA, New Delhi which are mandatory.

Program Outcomes (POs): Program outcomes describe what students are expected to know and would be able to do by the time of graduation. These relate to the skills, knowledge, and behaviours that students acquire as they progress through the program. Apart from the PO's every department has liberty to define its own Program Specific Outcomes (PSO's).

Program Specific Outcomes (Program has to specify 2 – 4 PSOs): Program Specific Outcomes are statements that describe what the graduates of a specific engineering program should be able to do.

PROCESS INVOLVED IN CO-PO MAPPING:

The role of CO-PO mapping will be assigned to the faculty as per hierarchy. After the course (subject) allotment from the department, the course in-charge of the course has to write appropriate COs for their corresponding course. It should be narrower and measurable statements. By using the action verbs of learning levels, CO's will be designed. CO statements should describe what the students are expected to know and able to do at the end of each course, which are related to the skills, knowledge and behaviour that students will acquire through the course.

After writing the CO statements, CO will be mapped with PO of the department. If the department is having more than one section in a year or the same course is available for more than one program of the same institute in a semester, the subject expert will be nominated as course coordinator of the corresponding course. The role of the course coordinator is to review the CO statements and the CO-PO mapping which has been done by course in-charge. The year wise coordinator has to consolidate the CO's of the respective year and maintain the documentation of the CO attainment level of the respective year courses as well as documentation of the individual students extra-curricular and co-curricular activities. These details will hand over to the program coordinator in order to evaluate PO attainment of the individual student as well as individual course at the end of the eighth semester. The Program coordinator has to evaluate the PO attainment of individual student through direct and indirect method after the student completing their program. All these works have to be done under the guidance of Department Advisory Committee (DAC).

Following are the different methods for Assessment, Evaluation and Measurement of POs/PSOs:

- **Direct Assessment methods**
- **Indirect Assessment methods**

DIRECT ASSESSMENT METHODS:

Continuous Assessment: COs are assessed through Sessional & Assignment Examinations and Lab records. The COs are mapped against each question and CO analysis is carried out by faculty for each course and documented. The contribution of COs are assessed in high, moderate and low levels, towards the attainment of POs/PSOs.

Semester-end Theory Examinations: The questions in semester-end examinations are tested pertaining to all COs, in varying Blooms Taxonomy Levels.

Laboratory Records: Both continuous and semester-end examinations are conducted to test the COs attainment.

INDIRECT ASSESSMENT METHODS:

Programme Exit survey: This survey taken from the final year students at the completion of their B.Tech programme, stands as the comprehensive feedback for the PO/PSO assessment

Alumni Survey: This survey is conducted annually through Google link or mail with the Alumni to obtain the inputs and suggestions on PO attainment in the real time societal environment

Employer Survey: This survey is taken from the employer to measure the PO attainments.

EXTERNAL EXAMINATION ASSESSMENT PROCESS:

NOTE:

Marks Range Theory (Max – 100)	Level	Letter Grade
≥ 90	Outstanding	A+
≥80 to <89	Excellent	A
≥70 to <79	Very Good	B
≥60 to <69	Good	C
≥50 to <59	Fair	D
≥40 to <49	Satisfactory	E
<40	Fail	F

RUBRICS:

If 50% of the students crossed D Grade: Attainment Level 1

If 60% of the students crossed D Grade : Attainment Level 2

If 70% of the students crossed D Grade: Attainment Level 3

External Examination Assessment for Laboratory subjects followed by the Rubrics

RUBRICS:

If 60% of the students crossed B Grade: Attainment Level 1

If 70% of the students crossed B Grade : Attainment Level 2

If 80% of the students crossed B Grade: Attainment Level 3

PROCEDURE:

1. Enter the question wise external marks.
2. Identify the CO of each question.
3. Calculate 50% of maximum marks of each question.
4. Find number of students crossed 50% of maximum marks for each question.
5. Find percentage of students crossed 50% of maximum marks for each question.
6. Find the attainment level of each question as per the above Rubrics.
7. Finally calculate CO attainment level by consolidating the question wise attainment levels.

INTERNAL EXAMINATION ASSESSMENT:

Internal Examination Assessment for Theory subjects followed by the Rubrics

RUBRICS:

If 50% of the students crossed 50% of the marks: Attainment Level 1

If 60% of the students crossed 50% of the marks: Attainment Level 2

If 70% of the students crossed 50% of the marks: Attainment Level 3

Internal Examination Assessment for Laboratory subjects followed by the Rubrics

RUBRICS:

If 60% of the students crossed 75% of the marks: Attainment Level 1

If 70% of the students crossed 75% of the marks: Attainment Level 2

If 80% of the students crossed 75% of the marks: Attainment Level 3

PROCEDURE:

1. Enter the question wise marks for mid examinations, assignments & quiz.
2. Identify the CO of each question.
3. Calculate the maximum marks of each CO based on mid exams, assignments and quiz.
4. Calculate the CO Wise marks obtained by each student.
5. Calculate 50% of maximum marks of each CO.
6. Find number of students crossed 50% of maximum marks for each CO.
7. Find percentage of students crossed 50% of maximum marks for each CO.
8. Find the attainment level of each CO as per the above Rubrics

CO ATTAINMENT:

CO Attainment using Direct Assessment:

Direct CO Attainment is calculated based on internal and external examinations.

$$\text{Direct CO Attainment \%} = 30\% \text{ of CIE} + 70\% \text{ of SEE.}$$

CO Attainment using Indirect Assessment:

It is based on course end survey. A google form is created to take the course end survey at the end of each semester for Indirect Assessment.

Total CO Attainment:

$$\text{CO Attainment \%} = 90\% \text{ of Direct CO Attainment} + 10\% \text{ of Indirect CO Attainment.}$$

EXAMPLE:

COURSE NAME: NON-CONVENTIONAL ENERGY RESOURCES

TARGET VALUE: 2.78

CO Overall Attainment					
CO'S	CO Attainment Level (Mid 30%)	CO Attainment Level (External 70%)	Direct CO Attainment Level - 90%	Course Exit Survey (Indirect CO attainment level)- 10%	TOTAL ATTAINMENT LEVEL (90% of Direct+ 10% of Indirect)
C321.1	3	3	3	2.77	2.98
C321.2	3	3	3	2.79	2.98
C321.3	3	3	3	2.77	2.98
C321.4	3	3	3	2.75	2.98
C321.5	3	3	3	2.77	2.98
C321.6	3	3	3	2.8	2.98
OVERALL COURSE ATTAINMENT OF C321					2.98

COURSE ASSESSMENT BASED ON INTERNAL MID EXAMINATIONS

USHA RAMA COLLEGE OF ENGINEERING & TECHNOLOGY, TELAPROLU

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE ASSESSMENT BASED ON INTERNAL MID EXAMINATIONS

FACULTY NAME: Mr. J. ASHOK KUMAR

COURSE & CODE : HT

YEAR: III

ACADEMIC YEAR: 2022-23

Regulation : UR20

SEM: II

S.No	Roll. No	STUDENT NAME	Test	Descriptive-1			Descriptive-2			CO I	CO II	CO III	CO IV	CO V	CO VI	CO I	CO II	CO III	CO IV	CO V	CO VI	ASSIGNMENT-1	ASSIGNMENT-2	OBJECTIVE-1	OBJECTIVE-2												
				Q.No	1	2	3	1	2																	3	Max. Marks	1	2	3	1	2	3				
				COs	I	II	III	IV	V																	VI	1	2	3	4	5	6	7	8	9	10	
1	20NG1A0301	ALUGULA VENKATA RAMANJANEYULU	30	4.0	4.0	4.0	5.0	4.0	4.0	4	4	4	5	4	4	2	2	2	2	2	2	5	5	9	9												
2	20NG1A0302	AREPALLI CHENNAKESAVA	30	5.0	5.0	5.0	5.0	5.0	4.0	5	5	5	5	5	4	2	2	2	2	2	2	5	5	9	9												
70	21NG5A0349	TINNALURI VENKATA VAMSI GOPI NAIDU	30	5.0			5.0	4.0	5.0	5			5	4	5	2	2	2	2	2	2	5	5	8	6												
71	21NG5A0350	TUNGALA NAGA MAHA AKHILESH	30	4.0	3.0	5.0	5.0	5.0	5.0	4	3	5	5	5	5	2	2	2	2	2	2	5	5	8	9												
Total Number of Students Answered									59	62	55	68	65	64	56	56	56	60	60	60					62	67											
50% of maximum marks									2.5	2.5	2.5	2.5	2.5	2.5	1	1	1	1	1	1					5	5											
No. of Students crossed 50% of max. marks									58	60	51	68	65	62	56	56	56	60	60	60					55	66											
% of students crossed 50% of max. marks									98	97	93	100	100	97	##	##	##	##	##							89	99										
Attainment Level									3	3	3	3	3	3	3	3	3	3	3	3					3	3											

The Attainment Levels as per the Bench Mark set for Cos of all courses is 50% maximum marks for each CO

Overall Attainment level = 50% of internal +16% of assignment + 34% of Quiz

Example: For C321.1, Overall Attainment = (0.5*3)+(0.16*3)+(0.34*3) = 3

FINAL INTERNAL CO ATTAINMENT

S.No	CO	ATTAINMENT LEVEL
1	C321.1	3
2	C321.2	3
3	C321.3	3
4	C321.4	3
5	C321.5	3
6	C321.6	3

COURSE ASSESSMENT BASED ON EXTERNAL GRADES:

USHA RAMA COLLEGE OF ENGINEERING & TECHNOLOGY, TELAPROLU

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE ASSESSMENT BASED ON UNIVERSITY GRADES

FACULTY NAME: Mr. J. ASHOK KUMAR **ACADEMIC YEAR: 2022-23**

COURSE & CODE : HT **Regulation : UR20**

YEAR: III **SEM: II**

S.No	Roll. No	NAME OF STUDENT	External Grade
1	20NG1A0301	ALUGULA VENKATA RAMANJANEYULU	D
2	20NG1A0302	AREPALLI CHENNAKESAVA	B
70	21NG5A0349	TINNALURI VENKATA VAMSI GOPI NAIDU	D
71	21NG5A0350	TUNGALA NAGA MAHA AKHILESH	C

No of Students Answered: 71

No. Of Students Crossed "D" Grade 55

Percentage of Students Crossed "D" Grade 77

Attainment Level 3

NOTE:

Marks Range Theory (Max – 100)	Level	Letter Grade	Grade Point
≥ 90	Outstanding	A+	10
≥80 to <89	Excellent	A	9
≥70 to <79	Very Good	B	8
≥60 to <69	Good	C	7
≥50 to <59	Fair	D	6

Rubrics:

If 50% of the students crossed D Grade: Attainment Level 1

If 60% of the students crossed D Grade : Attainment Level 2

If 70% of the students crossed D Grade: Attainment Level 3

CO Attainment using Indirect Assessment:

It is based on course end survey. A google form is created to take the course end survey at the end of each semester for Indirect Assessment.

USHA RAMA COLLEGE OF ENGINEERING AND TECHNOLOGY, TELAPROLU							
DEPARTMENT OF MECHANICAL ENGINEERING							
III B.TECH II SEMESTER COURSE END SURVEY 2022-23							
SUBJECT: HEAT TRANSFER							
S.No	Roll Number	CO1: Understand modes and mechanism of heat transfer	CO2: Analyze of one-dimensional transient conduction heat Transfer	CO3: Analyze of natural and forced convection	CO4: Understand the heat transfer with phase change	CO5: Analyze of heat exchangers	CO6: Understand the radiation heat transfer characteristics
1	20NG1A0301	2	3	2	3	3	3
2	20NG1A0302	3	3	3	2	2	3
70	21NG5A0349	3	3	3	3	3	3
71	21NG5A0350	2	3	3	3	3	3
	FINAL	2.77	2.79	2.77	2.75	2.77	2.80

Total CO Attainment:

CO Attainment % = 90% of Direct CO Attainment + 10% of Indirect CO Attainment.

CO Overall Attainment			
CO'S	Direct CO Attainment Level - 90%	Course Exit Survey (Indirect CO attainment level)- 10%	TOTAL ATTAINMENT LEVEL (90% of Direct + 10% of Indirect)
C321.1	3	2.77	2.98
C321.2	3	2.79	2.98
C321.3	3	2.77	2.98
C321.4	3	2.75	2.98
C321.5	3	2.77	2.98
C321.6	3	2.8	2.98
OVERALL COURSE ATTAINMENT			2.98

Model Calculation:

For C321.1 CO Direct attainment Level is 3, Indirect attainment level is 2.77.

Overall attainment = 90% Direct + 10% Indirect = $0.9 * 3 + 0.1 * 2.77$

$$= 2.7 + 0.277 = 2.977 \text{ is rounded to } 2.98$$

For C321.4 CO Direct attainment Level is 3, Indirect attainment level is 2.75.

Overall attainment = 90% Direct + 10% Indirect = $0.9 * 3 + 0.1 * 2.75$

$$= 2.7 + 0.275 = 2.975 \text{ is rounded to } 2.98$$

Course Articulation Matrix correlates the individual COs of a course with POs and PSOs. The Course Outcomes are mapped with POs and PSOs in the scale of 1 to 3.

The strength of correlation is indicated as 3 for **substantial (high)** 2 for correlation, **moderate (medium)** correlation, and 1 for **slight (low)** correlation.

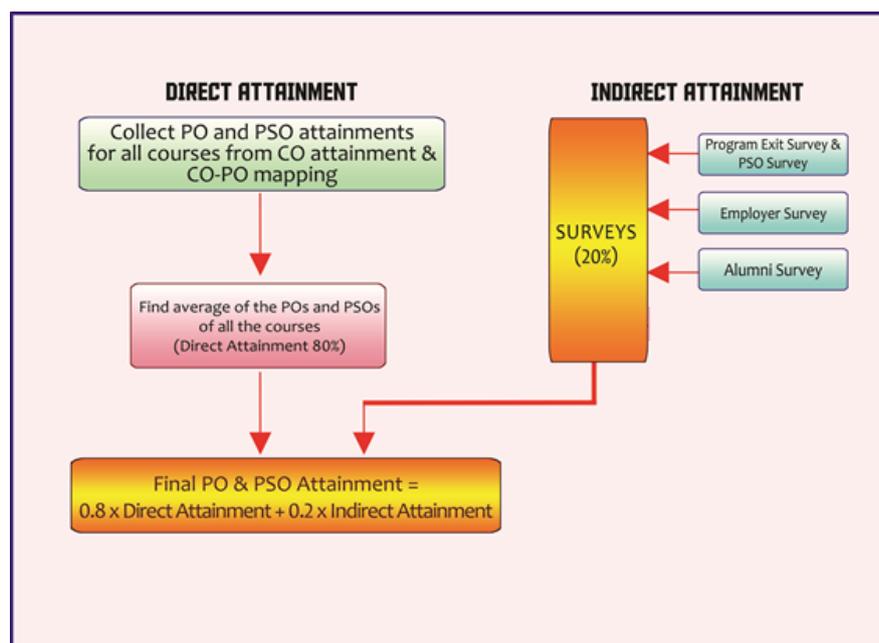
A typical CO-PO mapping and CO-PSO mapping table is shown below.

CO-PO MAPPING													
CO'S	PO'S											PSO'S	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C321.1	3	3	2	2	3	2	3	2			2	3	
C321.2	3	3	2	2	2	2	3	2			2	2	
C321.3	3	3	2	2	2	2	2	2			2	3	
C321.4	3	3	2	2	2	2	2	2			3	3	
C321.5	3	3	2	2	2	2	2	2			2	3	
C321.6	3	3	2	2	1	2	2	2			3	3	

ATTAINMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

ASSESSMENT TOOLS & PROCESSES:

Programme outcome (PO) attainment process and Programme specific outcome (PSO) attainment process is done through direct and indirect assessment tools. 80% of direct attainment and 20% of indirect attainment is considered for calculation of PO attainment and PSO attainment. The PO and PSO Attainment process is diagrammatically shown in the below figure

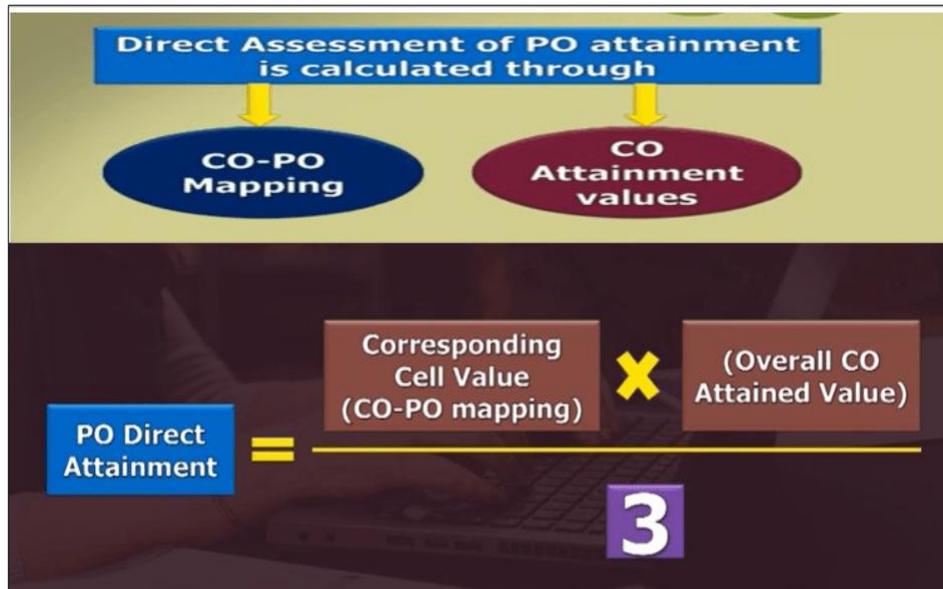


PO AND PSO ATTAINMENT PROCESS

Assessment tools and process used for evaluation of Program Outcomes and Program Specific Outcomes are presented below. Two different tools namely direct and indirect assessment tools are used.

DIRECT ASSESSMENT:

Direct assessment of programme outcomes and programme specific outcomes are based on the logical mapping of cognitive levels of course outcomes with programme outcomes and programme specific outcomes and the following formula are used to calculate programme outcomes and program specific outcomes of the respective courses.



PO attainment is calculated with the following formula:

PO Attainment = $PO_i * \text{Total CO attainment Level} / 3$ where 'i' ranges from 1 to 12

Where PO_i is average of all COs correlated with the i^{th} PO.

Ex: $PO_1 * \text{Total CO attainment Level} / 3$

PSO attainment is calculated with the following formula:

PSO Attainment = $PSO_i * \text{Total CO attainment Level} / 3$ where 'i' ranges from 1 to 3

Where PSO_i is average of all COs correlated with the i^{th} PSO.

Ex: $PSO_1 * \text{Total CO attainment Level} / 3$

Program Outcome (PO) Assessment

CO Overall Attainment			
CO'S	Direct CO Attainment Level - 90%	Course Exit Survey (Indirect CO attainment level)- 10%	TOTAL ATTAINMENT LEVEL (90% of Direct + 10% of Indirect)
C321.1	3	2.77	2.98
C321.2	3	2.79	2.98
C321.3	3	2.77	2.98
C321.4	3	2.75	2.98
C321.5	3	2.77	2.98
C321.6	3	2.8	2.98
OVERALL COURSE ATTAINMENT			2.98

CO-PO MAPPING													
CO'S	PO'S											PSO'S	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C321.1	3	3	2	2	3	2	3	2			2	3	
C321.2	3	3	2	2	2	2	3	2			2	2	
C321.3	3	3	2	2	2	2	2	2			2	3	
C321.4	3	3	2	2	2	2	2	2			3	3	
C321.5	3	3	2	2	2	2	2	2			2	3	
C321.6	3	3	2	2	1	2	2	2			3	3	

PO ATTAINMENT														
OVERALL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
	C321.1	2.98	2.98	1.98	1.98	2.98	1.98	2.98	1.98			1.98	2.98	
	C321.2	2.98	2.98	1.99	1.99	1.99	1.99	2.98	1.99			1.99	1.99	
	C321.3	2.98	2.98	1.98	1.98	1.98	1.98	1.98	1.98			1.98	2.98	
	C321.4	2.98	2.98	1.98	1.98	1.98	1.98	1.98	1.98			2.98	2.98	
	C321.5	2.98	2.98	1.98	1.98	1.98	1.98	1.98	1.98			1.98	2.98	
	C321.6	2.98	2.98	1.99	1.99	0.99	1.99	1.99	1.99			2.98	2.98	
Attainment	2.98	2.98	1.98	1.98	1.92	1.95	2.3	1.98			2.3	2.82		

Overall attainment for PO1 will be

$$= (3*2.98+3*2.98+3*2.98+3*2.98+3*2.98+3*2.98)/(3+3+3+3+3+3)$$

$$= 53.64/18$$

$$= 2.98$$

Overall attainment for PO3 will be

$$= (2*2.98+2*2.97+2*2.97+2*2.98+2*2.98+2*2.98)/(3+3+3+3+3+3)$$

$$= 35.76/18$$

$$= 1.986 \text{ and it is rounded to } 1.98$$

INDIRECT ASSESSMENT:

Indirect assessment is performed through the following surveys.

1. Program Exit Survey.
2. Employer Survey.
3. Alumni Survey.

Program Exit Survey.

It is based on Program exit survey A google form is created to take the end of the program and Assessment.

USHARAMA COLLEGE OF ENGINEERING & TECHNOLOGY															
DEPARTMENT OF MECHANICAL ENGINEERING															
PO AND PSO ASSESSMENT BASED ON ALUMNI SURVEY (INDIRECT ASSESSMENT)															
Admitted Batch: 2020-24															
S.No	Roll. No	NAME OF STUDENT	PROGRAM OUTCOMES											PSOs	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	20NG1A0304	BUDDANA VIJAY JEEVAN KUMAR	4	3	3	3	3	3	3	3	3	3	3	3	3
2	20NG1A0309	DERANGALA MAHESH KUMAR	4	3	3	3	3	3	3	3	3	3	3	3	3
14	21NG5A0340	THOMMANDRU RATNAKAR	3	4	4	4	4	4	4	5	4	4	4	4	5
15	21NG5A0350	TUNGALA NAGA MAHA AKHILESH	5	4	5	4	4	5	4	5	5	4	4	4	5
Number of students given feedback			15	15	15	15	15	15	15	15	15	15	15	15	15
Average on 5-point scale			3.73	3.87	3.93	3.93	3.73	4.07	4.13	4.07	3.93	3.93	3.93	3.87	4.07
Average on 3-point scale			2.25	2.33	2.38	2.34	2.25	2.45	2.48	2.42	2.37	2.37	2.37	2.31	2.42

Alumni Survey:



DEPARTMENT OF MECHANICAL ENGINEERING

ALUMNI SURVEY

Dear Alumna/Alumnus

Greetings from Usha Rama College of Engineering and Technology (URCET)! It really makes us feel very proud to have a student like you! URCET is growing from strength to strength because of your performance and the skill set that you have gained and exhibited from time to time.

URCET is now going for Outcome Based Education (OBE) accreditation as per Washington Accord. It will largely benefit graduates from URCET to work as an Engineering Professional in the member countries coming under the Washington Accord.

OBE requires that Programme Outcomes (POs) of the programme (Branch of Study) are to be clearly defined and attained by graduates during their stay in the campus. The Questionnaire is designed to survey the attainments of Programme Outcomes. Please take a few minutes to complete this survey and submit the same. Kindly rate the following criteria on a scale of 1-5. Your genuine response will be helpful for the continuous quality improvement of our UG programme in ECE.

5. Excellent 4. Very Good 3. Good 2. Average 1. Poor

S. No.	Criteria	Rating
1	Your ability to apply knowledge of mathematics, science, and engineering in solving Mechanical problems.	3
2	Your ability to identify, formulate, and solve complex engineering problems.	5
3	Your ability to design Mechanical designs that meet desired needs within constraints.	5
4	Your ability to conduct investigations and interpret data for drawing valid conclusions.	5
5	Your familiarity with modern tools and their application in ME practice.	4
6	Your understanding of societal, health, safety, legal and cultural issues relevant to engineering.	5
7	Your understanding of the impact of engineering solutions in a global, economic, environmental context.	5
8	Your commitment to professional ethics and responsibilities.	4
9	Your ability to function effectively as an individual and in multidisciplinary teams.	4
10	Your ability to communicate effectively in professional environments.	5
11	Your knowledge of engineering and management principles in team and project environments.	5

12	Your ability to engage in lifelong learning and adapt to technological change.	5
13	Your ability to apply ME knowledge to analyze and solve domain-specific problems.	5
14	Your ability to design and develop Mechanical Engineering using modern tools and techniques.	5

B. Vijaya Prasanna Babu
Signature

Name (in Capitals): B. VIJAYA PRASANNA BABU

B.Tech. Roll Number: 21NG5A0305

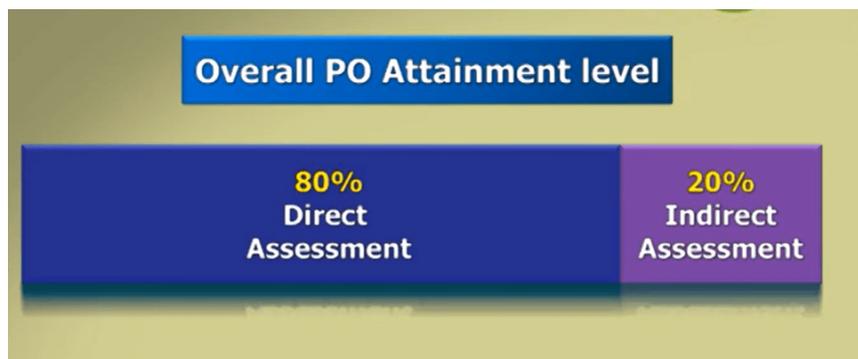
Relation of POs and PSOs with questionnaire: (2021-2024)

POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14

Evaluation Process

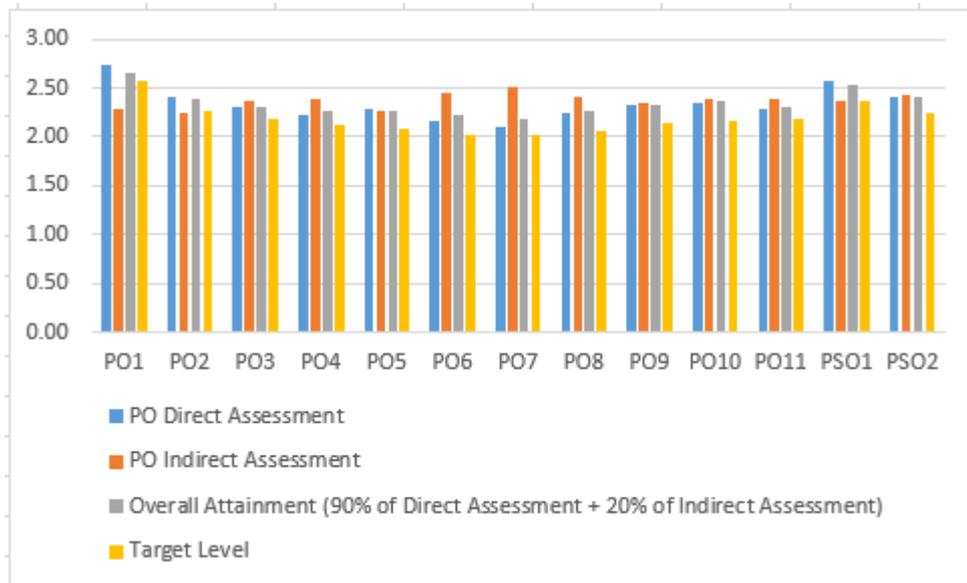
The questionnaire consists of 14 questions which are relevant for assessing each PO and PSO. Each question is having 5 options namely Excellent, Very Good, Good, Average and Poor, which is given marks 5, 4, 3, 2, 1 respectively. These marks are to be tabulated and the average values corresponding to each PO and PSO are to be determined on a 3-point scale.

OVERALL LEVELS OF ATTAINMENT:



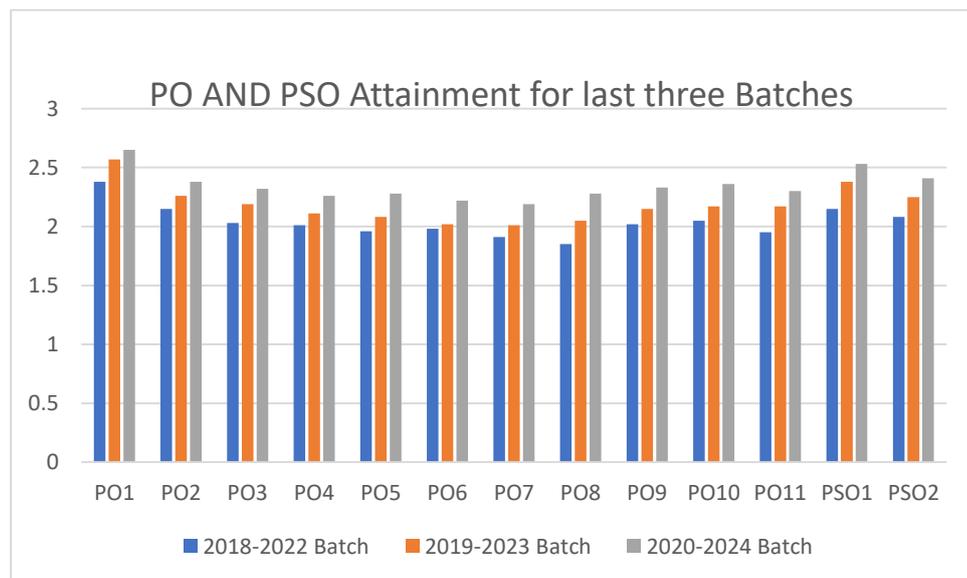
OVERALL LEVELS OF PO ATTAINMENTS & PSO ATTAINMENTS

2020-2024 Batch	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
PO Direct Assessment	2.74	2.42	2.30	2.22	2.28	2.17	2.11	2.24	2.32	2.35	2.28	2.58	2.40
PO Indirect Assessment	2.29	2.24	2.37	2.39	2.26	2.44	2.52	2.41	2.35	2.39	2.40	2.36	2.42
Overall Attainment (90% of Direct Assessment + 20% of Indirect Assessment)	2.65	2.38	2.32	2.26	2.28	2.22	2.19	2.28	2.33	2.36	2.30	2.53	2.41
Target Level	2.57	2.26	2.19	2.11	2.08	2.02	2.01	2.05	2.15	2.17	2.17	2.38	2.25



OVERALL THREE BATCHES OF PO ATTAINMENTS & PSO ATTAINMENTS

Batch	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
2020-2024 Batch	2.65	2.38	2.32	2.26	2.28	2.22	2.19	2.28	2.33	2.36	2.3	2.53	2.41
2019-2023 Batch	2.57	2.26	2.19	2.11	2.08	2.02	2.01	2.05	2.15	2.17	2.17	2.38	2.25
2018-2022 Batch	2.38	2.15	2.03	2.01	1.96	1.98	1.91	1.85	2.02	2.05	1.95	2.15	2.08



The eleven steps towards validation of POs are as follows:

Step 1: Defining the Vision and Mission of the Department.

Step 2: Defining Program Educational Objectives (PEOs) of the Department.

Step 3: Establishing POs to setup target level of PO attainment.

Step 4: Defining relation between Course Outcomes (COs) and POs for each course to obtain overall CO mapping with each POs.

Step 5: Development of overall CO-PO mapping matrix for all courses.

Step 6: Computation and construction of overall CO attainment matrix for each course using course assessment tools.

Step 7: Calculation and construction of direct PO attainment matrix using overall CO-PO mapping matrix and overall CO attainment matrix.

Step 8: Calculation of overall direct PO attainment.

Step 9: Calculation of indirect PO attainment.

Step 10: Computation of overall PO attainment.

Step 11: Comparison of target level and obtained PO attainment.

USHARAMA

COLLEGE OF ENGINEERING AND TECHNOLOGY

On NH16, Telaprolu, Near Gannavaram, Krishna Dist. – 521109

Ph.: 0866-2527558, www.usharama.edu.in

(An Autonomous Institute, Approved by AICTE, New Delhi, Permanently Affiliated to JNTUK, Kakinada)

DEPARTMENT OF MECHANICAL ENGINEERING

List of Courses for UR20 Regulation and their Codes

CODE	COURSE	CODE	COURSE
I SEMESTER		II SEMESTER	
C111	Problem Solving and Programming using C	C121	Engineering Physics
C112	Communicative English	C122	Basic Electrical & Electronics Engineering
C113	Engineering Chemistry	C123	Engineering Mechanics
C114	Linear Algebra & Calculus	C124	Differential Equations & Vector Calculus
C115	Engineering Graphics & Drafting	C125	Engineering Workshop & IT Tools
C116	Problem Solving and Programming using C Lab	C126	Engineering Physics Lab
C117	Communicative English Lab	C127	Basic Electrical & Electronics Engineering Lab
C118	Engineering Chemistry Lab	C128	Computer Aided Modeling & Drafting lab
		C129	Science, Technology & Society (Non-Credit Course)
		C1210	Social Service Activity I NCC/NSS/Social service club (Non-Credit Course)
III SEMESTER		IV SEMESTER	
C211	Numerical Methods & Transforms	C221	Metallurgy & Material science
C212	Engineering Thermodynamics	C222	Operations Research
C213	Fluid Mechanics & Hydraulic Machines	C223	Dynamics of machinery
C214	Production Technology	C224	Mechanics of Solids
C215	Kinematics of machinery	C225	Industrial Engineering & Management
C216	Machine drawing	C226	Design and analysis Lab
C217	Fluid Mechanics & Hydraulic Machinery Lab	C227	Theory of Machines Lab
C218	Production Technology Lab	C228	Materials Testing Lab

C219	Python programming Lab	C229	Statistical Quality Control Lab
C2110	Environmental science (Non-Credit Course)	C2210	Community service project
C2111	Social Service Activity-II (NCC/NSS/Social service club (Non-Credit Course))		
V SEMESTER		VI SEMESTER	
C311	Applied Thermodynamics	C321	Heat Transfer
C312	Design of Machine Members-I	C322	Design of Machine Members II
C313	Machining and Machine Tools	C323	Metrology & Instrumentation
C314B	Automobile Engineering	C324A	CAD/CAM
C314D	Nano Technology	C324B	Industrial Robotics
C315A	Renewable Energy Sources	C325A	Dissaster Management
C315B	Basic Electronics	C325B	Fundamentals of Utilization of Electrical Energy
C316	Thermal Engineering Lab	C326	Heat Transfer Lab
C317	Machine Tools Lab	C327	Metrology & Instrumentation Lab
C318	summer Internship	C328	Simulation Lab
C319	Mechatronics Lab	C329	Soft skills Lab
C3110	Research methodology and IPR (Non-Credit Course)	C3210	Constitution Of India (Non-Credit Course)
VII SEMESTER		VIII SEMESTER	
			Project work, seminar and internship in industry
C411	Power plant Engineering	C421	
C412	Production Planning and Control		
C413	Non Destructive Evaluation		
C414	Transducers and Sensors		
C415	Air Pollution and Control		
C416	Universal Human Values: Understanding Harmony		
C417	Computational Fluid Dynamics Lab		
C418	Evaluation of Industrial / Research Internship (Completed at the end of 3rd year 2nd sem)		
C419	Essence of Indian traditional knowledge (Non-Credit Course)		