



# ADITYA COLLEGE OF ENGINEERING

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## OUT COME - BASED EDUCATION

**Outcomes-based Education (OBE):** It is a comprehensive approach to organizing and operating a curriculum that is focused on and defined by the successful demonstrations of learning sought from each learner. The term clearly means focusing and organizing everything in an education system around “what is essential for all learners to be able to do successfully at the end of their learning experiences”.

OBE ultimately implies emerging with a vivid idea of what is important for learners to be able to do thereafter developing the programmes for learning, implementing it and assessing the learner on a continuous basis to ensure that learning has ultimately taken place. The outcomes-based approach to education requires developing a clear set of outcomes organized into the system's subjects and Establishing conditions and opportunities within the system to enable and encourage learners to achieve these outcomes.

**The Shift from Content-based Education to Outcome-based Education** The aim of education is to prepare learners for life in society and for performing tasks. It is the intention of the outcomes-based approach to focus as much on the process of learning and the final outcome or result, as on the knowledge and skills. In this way, the process of achieving outcomes during the process of learning can be related directly to the way in which outcomes are achieved in the world of work. The purpose of OBE is to increase the knowledge and skills of the learners. By introducing OBE, opportunities may arise for who's academic or career paths were stifled due to their prior knowledge not being assessed and certified.

**Focus and Benefits of OBE:** OBE addresses the following key questions:

- What do we want the students to have or be able to do?
- How can we best help students achieve it?
- How will we know whether they students have achieved it?
- How do we close the loop for further improvement (Continuous Quality Improvement?)

Benefits of OBE:

- Graduates will be more “relevant” to industry & other stakeholders (more well rounded graduates)
- Continuous Quality Improvement (CQI) is in place. OBE shifts from measuring input and process to include measuring the output (outcome).

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Some important aspects of the Outcome Based Education:

1. **Course:** It is defined as a theory, practical or theory cum practical subject studied in a semester. For Eg. 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. **Programme:** It 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. **Programme 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 Programme 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. **Programme Specific Outcomes (PSO):** Programme 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 programme.
7. **Graduate Attributes (GA):** The graduate attributes, 12 in numbers are exemplars of the attributes expected of a graduate from an accredited programme

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## PROGRAM OUTCOMES (POs):

PO1	Engineering knowledge	An ability to apply knowledge of mathematics (including probability, statistics and discrete mathematics), science, and engineering for solving Engineering problems and Knowledge.
PO2	Problem analysis	An ability to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software components.
PO3	Design / development of solutions	An ability to design a complex electronic system or process to meet desired specifications and needs.
PO4	Conduct investigations of complex Problem	An ability to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions.
PO5	Modern tool usage	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
PO6	The engineer and society	An understanding of professional, health, safety, legal,
PO7	Environment and sustainability	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and demonstrate the knowledge need for sustainable development
PO8	Ethics	Apply ethical principles, responsibility and norms of the engineering practice.
PO9	Individual and teamwork	An ability to function on multi-disciplinary teams.
PO10	Communication	An ability to communicate and present effectively
PO11	Project management and finance	An ability to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments
PO12	Life-long learning	A recognition of the need for, and an ability to engage in, to resolve contemporary issues and acquire lifelong learning

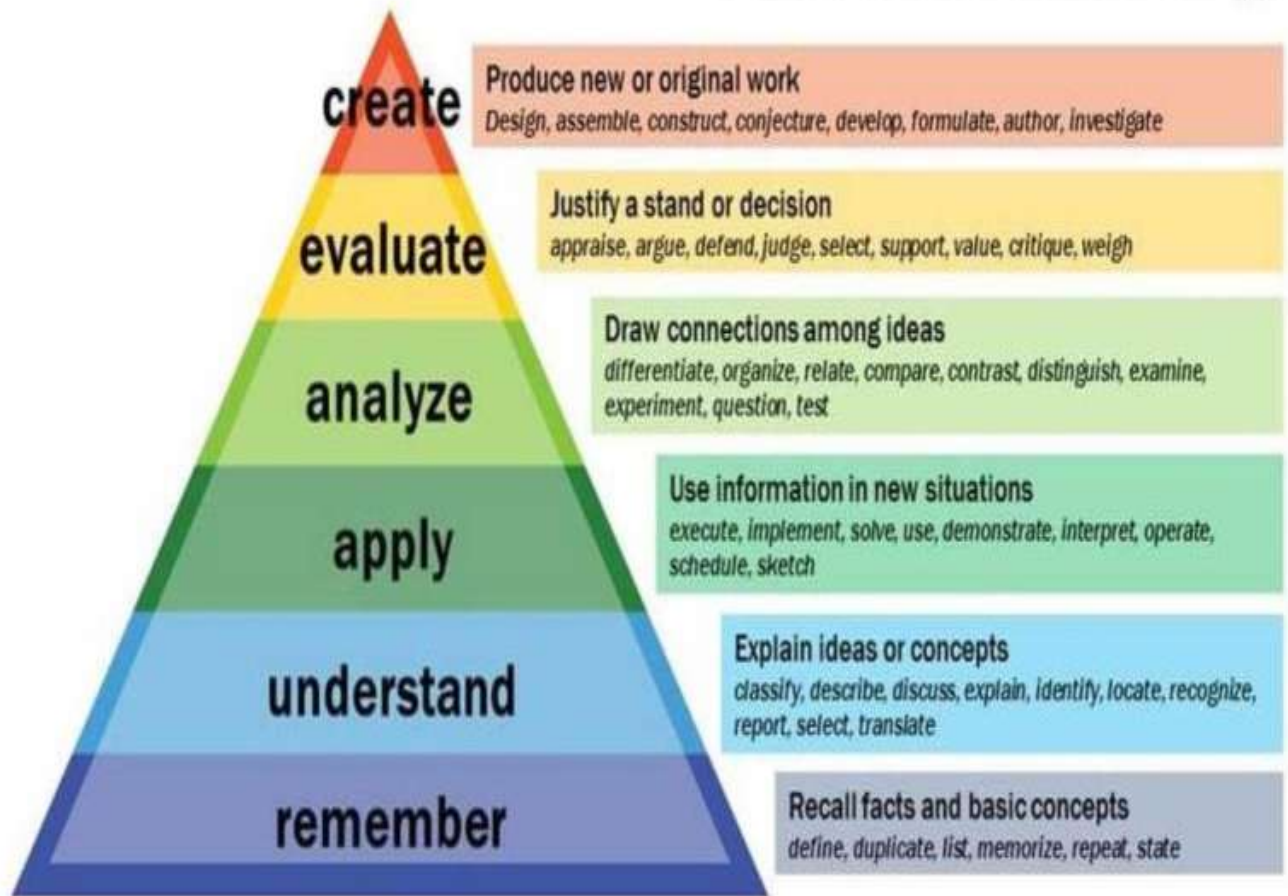
## BLOOM'S TAXONOMY

Bloom's Taxonomy was created in 1956 under the leadership of educational psychologist Dr Benjamin Bloom in order to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts. It is most often used when designing educational, training, and learning processes.

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# Bloom's Taxonomy



Domain	Keywords	Example
Remembering: Recall or retrieve previous learned information.	defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, select, state.	Recite a policy. Quote Prices from memory to a customer. Recite the safety rules.
Understanding: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.	comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates	Rewrite the principles of test Writing. Explain in one's own words The steps for performing a complex task. Translate an equation into a Computer spread sheet.
Analyzing: Separates material or concepts into component parts so that its Organizational structure may be understood. Distinguishes between facts and inferences.	analyzes, breakdown, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates	Troubleshoot a piece of equipment By using logical deduction. Recognize logical fallacies in reasoning. Gathers information from a department and selects the required tasks for training.

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Evaluating: Make judgments about the value of ideas or materials.	appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports	Select the most effective solution. Hire the most qualified candidate. Explain and justify a new budget.
Creating: Build a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes	Write a company operations or process manual. Design a machine to perform as specific task. Integrate training from several sources to solve a problem. Revises and process to improve the outcome.

## COURSE OUTCOME STATEMENT

### 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.

### CO – PO AND CO – PSO MAPPING OF COURSES

All the courses together must cover all the POs (and PSOs). For a course we map the COs to POs through the CO-PO matrix and to PSOs through the CO-PSO matrix as shown below. The various correlation levels are:

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-” indicates there is no correlation.

### Levels of Outcomes

There are four levels of outcome such as Course Outcome (CO), Program Outcome (PO), Program Specific Outcome (PSO) and Program Educational Objective (PEO). Course Outcomes are the statements that declare what students should be able to do at the end of a course. POs are defined by Accreditation Agencies of the country (NBA in India), which are the statements about the knowledge, skills and attitudes, graduate attributes of a formal engineering program should have. Graduates Attributes (GAs) are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. GAs form a set of individually assessable outcomes of the program. The NBA laid down the graduate attributes relating to program outcomes and is to be derived by program.

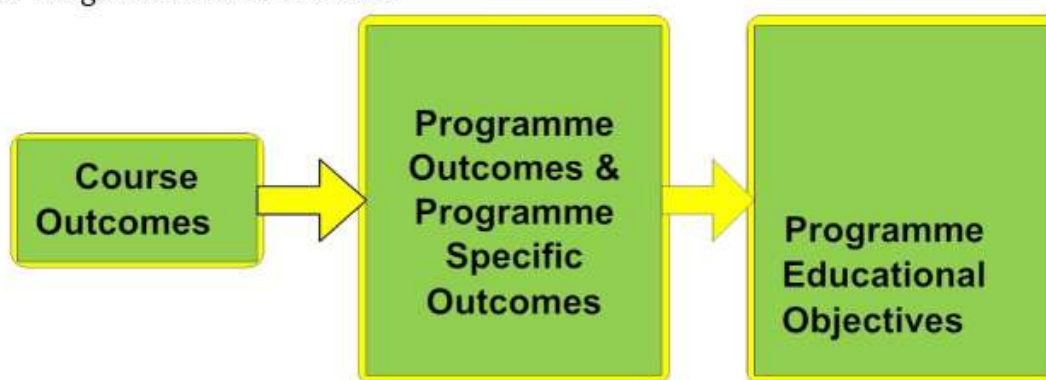
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The Program outcomes reflect the ability of graduates to demonstrate knowledge in fundamentals of Basic Sciences, Humanities and Social Sciences, Engineering Sciences and apply these principles in understanding and practically apply the knowledge in professional core subjects, electives and projects which enables the graduates to be competent at the time of graduation. The graduates must adhere to professional and ethical responsibilities in the pursuit of their careers and also for the benefit of the society.

The proper definition and the attainment of POs contribute to the attainment of Program Educational Objectives which will help the graduate to perform his/ her duties, professional responsibilities, design, development, production and testing of novel products, ability to deal with finances and project management during his/her early professional career of 3 to 4 years.

Program Specific Outcomes are the statements that assert what the graduates of a specific engineering program should do what they can able to do. Program Educational Objectives are the broad statements which describe in detail about the career and professional accomplishments after significant years of graduation that the program prepares the graduates to achieve.



Relating the outcomes (CO-PO&PSO-PEO)

After CO statements are developed by the course in-charge, CO will map with any possible PO's based on the relationship exist between them. But the PO's are not necessarily mapped with any one CO and it may be left blank. Anyhow, it is mandatory that all POs should be mapped with any one of PSO and PEO which are specified in the program.

### Process involved in CO-PO Mapping

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 behavior 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

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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 student's extra-curricular and co-curricular activities. These details will hand over to the Department Academic Committee in order to evaluate PO attainment of the individual student as well as individual course at the end of the eighth semester. The Department Academic Committee has to evaluate the PO attainment of individual student through direct and indirect method after the student completing their program.

### Assessment process:

#### Assessment Process for CO Attainment:

For the evaluation and assessment of CO's and PO's, rubrics are used. The rubrics considered here are given below:

#### (i). CO Assessment Rubrics:

Course Outcome is evaluated based on the performance of students in internal assessments and in university examination of a course. Internal assessment contributes 30% and university assessment contributes 70% to the total attainment of a CO.

#### (ii) CO-Assessment Process:

- Assessment Parameters: The performance of a student in each semester shall be evaluated course - wise with a maximum of 100 marks for theory course and 100 marks for laboratory.

#### 1. Theory course:

- ✓ Pattern for Internal Midterm Examinations: For theory courses of each semester there shall be two midterm descriptive & objective exams. Each descriptive & objective exam consists of 80 minutes. The mid exams will be taken for the assessment of internal marks. The first Midterm examination will be conducted usually after 7 weeks of instruction; the second Midterm examination will be conducted at the end of the semester.
- ✓ CO-wise assessment Rubrics: Every mid-exam question and every assignment is mapped to a specific CO. Thereafter, a CO -wise cut-off value is taken based on the highest mark secured for that CO and the number of students with their internal mark above the cut- off value is considered for rating the CO attainment(Example):

✓ No. of students having marks > cut-off	✓ Rating in 3 scale ( 1 )
✓ $\geq 60\%$	✓ 3
✓ 50% to 59%	✓ 2
✓ 40% to 49%	✓ 1

- ✓ Pattern for External End Examinations: There shall be an external examination

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for every theory course and consists of two parts (part- A and part-B). The

duration of the time for this end examination is 3 hours.

- ✓ Assessment Rubrics: An overall cut-off value is taken for all CO's commonly based on the highest mark secured and the number of students with their external mark above the cut-off value is considered for rating all CO attainments. (Example):

✓ No. of students having marks > ✓ cut-off	✓ Rating in 3 scale ( E )
>=60%	3
50% to 59%	2
40% to 49%	1

Overall Attainment: The Final CO attainment is calculated by combining the internal attainment and External attainment in a ratio of 25: 75.

Final Value (V) = 30% of Internal Level (I) + 70% of External Level (E) (R20 regulation)

## 2. Laboratory Course:

Pattern for Lab Examinations: For practical subjects, there shall be continuous internal evaluation during the semester for 35 marks. 15 marks for day to day work, 5 for record and total 50 marks to be awarded by conducting laboratory test and for 5 marks for Viva- voce.

CO-wise assessment Rubrics (Example):

No. of students having marks > cut-off	Rating in 3 scale ( E )
>=60%	3
50% to 59%	2
40% to 49%	1

Project Work Evaluation: Mini-Project:

There shall be an industry-oriented Mini-Project, in collaboration with an industry of their specialization, to be taken up during the vacation after III-year II Semester examination. However, the mini-project and its report shall be evaluated along with the project work in IV- year II Semester. The industry oriented mini-project shall be submitted in a report form and presented before the committee. It shall be evaluated for 50 marks. The committee consists of an external examiner, head of the department, the supervisor of the mini-project and a senior faculty member of the department. There shall be no internal marks for industry-oriented mini-project.

Major project:

- ✓ Project batches are formed as per the instruction given by project coordinators.
- ✓ Synopsis will be submitted to the project coordinators for scrutinizing. Project Batches are allotted to the internal guides based on the specialization and competency

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- ✓ skills of the faculties.
- ✓ Each internal guide will continuously monitor their students on a weekly basis to observe the progress of the work.
- ✓ The project guide along with project coordinator conduct 3 project reviews as per the rubrics, which is set by the Department and the submit the Internal Assessment marks to the Head of Department.
- ✓ External Project Viva voce is conducted by the panel of examiners deputed by the University.
- ✓ Based on the viva voce the marks are awarded to the students and submitted to university.
- ✓ The department will encourage students to participate in technical Expo and the project guides motivate and guide the students to publish in standard conference/journal forums.

Attainment of Program Outcomes and Program Specific Outcomes: The following are the Assessment Tools:

Several tools are described for assessing course outcomes. The program outcomes are based on the course outcomes. Thus, the tools remain the same for assessing the program outcomes. In addition, the tools of survey based on the alumni and exit surveys are considered.

1. The tools broadly are
2. End of course surveys (half yearly)
3. Student exit surveys
4. Alumni surveys yearly
5. Staff surveys – yearly
6. Higher education and placement – student publications.

### Internal Assessment Tools

Component	Evaluation Components	Nature of Exam
Theory	MCQ's	Multiple choice questions
	First Mid Exam	Short essay and long essay questions
	End Mid exam	Multiple choice questions
	MCQ's	Short essay and long essay questions
	Daily evaluation	Planning, analysis of labskills, finishing The experiment

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Practical	Practical examination	Synopsis, spotting and viva-voce, major experiment and minor experiment
	Laboratory manual	Communication, data interpretation
Beyond syllabus	Conducting 02 experiments	
Overall Evaluation	External exam –semester wise	

### University examinations:

Component	Components of Evaluation	Nature of exam
Theory	University end exams	Short essays, long essays, numerical Problems
Practical	University end exams	Synopsis, spotting, major experiment, minor experiment, interpretation, data analysis, viva voce, communication

### Assessment process:

The assessment tools are direct and indirect methods for evaluating the attainment of POs. Direct methods:

Through the internal and external assessment, the teacher can focus on the PO's. The question papers include, short answers, short essay and long essay type. In addition, MCQs examinations are conducted on each unit test. Assignments are given for some extension of syllabus. In case of laboratory examination, synopsis, major experiment, minor experiment, viva voce, reports, etc., are the components. While setting a question paper, each question is framed based on the POs in order to attain them to a large extent. A few POs of minor

importance may not be accommodated. It is necessary that a question has to cover 60% of 'essentials to know', 30% 'better to know' and 10% are 'nice to know'. Therefore, special attempts are made to attain these objectives.

The subjects are also categorized as professional core subjects, basic science subjects (mathematics, science, computing, and humanities) and Engineering Sciences. Accordingly, the POs have assumed adequate importance. Having set the question papers, the answer papers are being evaluated from the same perspectives. The students are given feedback and POs are highlighted. Data are gathered after scrutinizing the answer for course outcomes. The course outcomes are translated to POs. Attainment of POs is considered from the data of all students.

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1. Indirect method: Survey is conducted from two levels: alumni and exit survey.
2. Direct method: Given below:

S. No.	Direct Assessment	Method Description
1.	Internal Assessment Test	The Internal Assessment marks in a theory paper shall be based on two tests generally conducted at the end of 8 and 16 weeks of each semester (20) and assignment (5). An improvement test may be conducted for the desirous students before the end of the semester to give an opportunity to such students to improve their Internal Assessment Marks. It is a metric to continuously assess the attainment of course outcomes w.r.t course objectives. Average of the two tests marks obtained shall be the Internal Assessment Marks for the relevant subject.
2	Assignment	Assignment is a metric to mainly assess student's knowledge/skills/attitude with their designing capabilities.
3	Lab Assignments	Lab Assignment can be one of the measuring criteria to mainly assess student's practical knowledge with their designing capabilities. In case of Practical, the IA marks shall be based on day to work in the lab (10) and one practical exam (15).
4	Theory Semester Examination	Semester examination (theory or practical) are the metric to assess whether all the course outcomes are attained or not framed by the course owner. Semester Examination is more
5	Practical Semester Examination	focused on attainment of course outcomes and uses a descriptive exam. Practical semester examination focuses on conduction of experiments and viva-voce.
6	Seminar	The IA marks in the case of mini projects, projects and seminars in the final year shall be based on the evaluation at the end of 8th semester by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the project / seminar guide.
7	Mini project	
8	Major Project	

**IQAC Coordinator**

**Dean (Academics & Administration)**

**Principal**

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