A HANDBOOK ON
OUTCOME BASED EDUCATION

Sacred Heart College (Autonomous) Tirupattur – 635 601.

PREAMBLE

Outcome Based Education (OBE) is a model that provides a strong scaffold to enhance the quality of the educational system. There are several styles of teaching and assessment in OBE. All educational activities carried out in OBE helps the students to achieve the set goals. The faculty may adapt the role of instructor, trainer, facilitator, and/or mentor, based on the outcomes targeted. OBE enhances the traditional methods and focusses on what the institution provides to students. It shows the success by making or demonstrating outcomes using statements "able to do" in favor of students. OBE provides clear standards for observable and measurable outcomes.

OBE and Accreditation in India

From 13 th June 2014, India has become the permanent signatory member of the Washington Accord. Implementation of OBE in higher technical education. So the National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) in order to promote global quality standards in technical education have 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.

Expectations of students' outcome under OBE

• Students are expected to be able to do more challenging tasks other than memorize and reproduce what was taught.

• Students should be able to: write project proposals, complete projects, analyze case studies, give case presentations, show their abilities to think, question, research, and make decisions based on the findings.

• Be more creative, able to analyze and synthesize information.

• Able to plan and organize tasks, able to work in a team as a community or in entrepreneurial service teams to propose solutions to problems and market their solutions.

• Students should be enriched on three dimensional scales of knowledge, skill and attitude throughout the course.

This handbook is intended to help teachers, staff, and other stakeholders understand the tenets of Outcomes Based Education (OBE) system, implemented at Sacred Heart College from the academic year 2021. It offers a thorough illustration of outcome based education that is carried out using the four stages of educational procedure, comprising curriculum design, teaching and

learning processes, assessment and evaluation, and continuous quality improvement. OBE focuses on the accomplishment of the outcomes by the students at each level and gain qualitative progress in their learning. The Graduate Attributes of the programmes are framed in accordance with the Institution's Vision and Mission and UGC guidelines. The Programme Educational Objectives (PEO), Programme Specific Outcomes (PSO), Programme Outcomes (PO) and Course Outcomes (CO) are formulated to achieve the aims of the Graduate Attributes. This handbook facilitates the drafting of an effective curriculum development and instructional strategy.

ABOUT SACRED HEART COLLEGE

Sacred Heart College is an affiliated First Grade College of Thiruvalluvar University.It is a minority institution, established and administered by the Salesians of Don Bosco(SDB).The first care of the management is to give Higher Education to the Catholic youth in a Christian atmosphere of peace, justice and social responsibility with a preferential option for the poor among them. The College is also open to students of all castes and creeds other than Catholics. Their religious beliefs are respected in this institution

ery Rev. Fr. Joseph Carreno SDB, a far-sighted missionary from Spain founded Sacred Heart College in the year 1951. It started functioning with 10 teachers and 81 students and in a short period of seven decades, it has grown into a postgraduate and research. With the view to cater to the needs of the deserving local students, the college also offers Undergraduate Programmes and Postgraduate Programmes in the Shift-II on self-financing basis. Recognizing its academic contributions, the University of Madras conferred the autonomous status on the Postgraduate Programmes of MSW (Social Work) and M.Sc. (Mathematics) from the academic year 1987-88. Subsequently, in the year 1988-89, autonomous status was conferred on the postgraduate programme of M.A. (Economics) and on all the Undergraduate Programmes. Meanwhile the Shift-II affiliated to Thiruvalluvar University, Vellore, was functioning in the non-autonomous mode. The College received the approval from AICTE (All India Council for Technical Education) to commence MCA programme on self-financing basis from the academic year 1998-99.In the same year, the College was accredited for the first time by NAAC with Four Stars.

In 2000, the College initiated evening study centres for the poor students in different villages around Tirupattur. The economically poor students were chosen to teach in these study centres and they were given work-scholarships. The golden jubilee of the College was celebrated in 2001 and a memorial building was opened to accommodate additional departments which were

started. In 2003, the Madras University was bifurcated and Sacred Heart College came under the Thiruvalluvar University. In the same year, Amalgam hostel was started to accommodate the post graduate women students in the campus.

In 2006, NAAC reaccredited the College with 'A' Grade. 'Guezou Hostel' for men was inaugurated to accommodate the increasing number of men students. In 2007, Autonomous Status was conferred on to the entire College and the College opened itself to admit women students in UG Programmes. In the very next year we introduced Choice Based Credit System (CBCS) was introduced. Besides many Undergraduate and postgraduate programmes from the Thiruvalluvar University, the AICTE approved MBA Programme. In 2012, the College focused itself on research and a research centre was created and it was named as Abdul Kalam Research Centre (APRC). In 2013, the College was once again accredited by NAAC (3rd Cycle) with 'A' Grade. From the year 2015, digitalization of administration began and it is very successful mainly due to the in-house development of softwares. The year 2016 saw a new entrance and a well furnished new building (Bicentenary Building) to accommodate more number of departments. In the same year restructuring of all the courses were done after a long process of consultation and academic audit of all departments. In 2017, the Ministry of Human Resource Development, Government of India has ranked our College as 95th College in India. Over these years the College included additional degree courses and diploma courses to provide quality education to more young people. As we see the College undertook a forward march and never turned back. We continue to march together with our faculty, staff and students towards excellence.

VISION, MISSION AND CORE VALUES

VISION

We, the community of Sacred Heart College, inspired by the love of the Heart of Jesus and fundamental human values, following the educative system of Don Bosco, are committed to the creation of an educated, ethical, and prosperous society where equality, freedom and fraternity reign by imparting higher education to poor and rural youth which enables them towards integral human development.

MISSION
In the field of Higher Education we are committed to

Academic excellence

- Healthy standards in extracurricular practices
- Social relevant research
- Courses leading to employment and entrepreneurship, and

- Continuous progress of the institution

Socially, we work towards

- Serving preferentially the underprivileged and rural youth
- Educating them to social consciousness of rights and responsibilities
- Rooting out social evils, building communities, and
- Promoting total literacy, education and development of the neighbourhood

Spiritually, we aim at

- Integrating ethical, cultural and political values
- Developing a sense of the Divine present in nature and in the human person
- This is done by means of group activities and personal guidance, in a family atmosphere

In this way, we are READY FOR EVERY GOOD WORK (ad omne opus bonum instructi) in collaboration with the government and people of good will, to create a society more worthy of human beings.

CORE VALUES

- Primacy of God
- Honesty
- Respect for all
- Being Responsible
- Pursuit of Excellence

OBE AND ACCREDITATION

Implementation of OBE in higher education in India has been mandated by The National Assessment and Accreditation Council (NAAC) and National Board of Accreditation(NBA) for promoting global quality standards for education in India. Reports of outcome analysis help to find gaps and carryout continuous improvements in the education system of an institute, which is vital for progress towards excellence.

OVERVIEW

The outcome based education (OBE) is an educational approach that serves as the cornerstone of a high-quality educational system. It employs multiple styles of teaching and assessment as part of the instructional processes. All educational activities carried out in OBE help the students to achieve the set goals. Based on the desired goals, the faculty may change their function as a teacher, trainer, facilitator, and/or mentor. The main idea driving this strategyis that by the end of the educational process, every student should have accomplished the objective.

OBE builds on conventional approaches and offers precise guidelines for measurable and observable outcomes.

BENEFITS OF OBE

- **Clarity**: The focus on outcome creates a clear expectation of what needs to be accomplished by the end of the course. ·
- **Flexibility**: With a clear sense of what needs to be accomplished, teachers will be able to structure their courses around the specific outcomes.
- **Comparison**: there is scope to make comparison across individual, class, programme and institute levels.
- **Involvement**: Students are involved in active learning.

Thus OBE is a learner-centric approach to education that focuses on what a student should be able to do by aligning the different levels of Benjamin Bloom's taxonomy by achieving observable and measurable learning outcomes. Learning outcomes are statements of the primary skills, knowledge, attitudes, abilities and proficiencies the learner will "own" at the end of the course. The key to success in outcome based education is clarity, for both teachers and students to understand what's expected of them. In addition to understanding what's expected, outcome based education also encourages transparency. The basic principle of outcome based education is that students must meet a specific standard to graduate. OBE is a student-centric learning model that helps teachers to plan the course delivery and assessment as follows:

- OBE- Education
- OBC-Curriculum
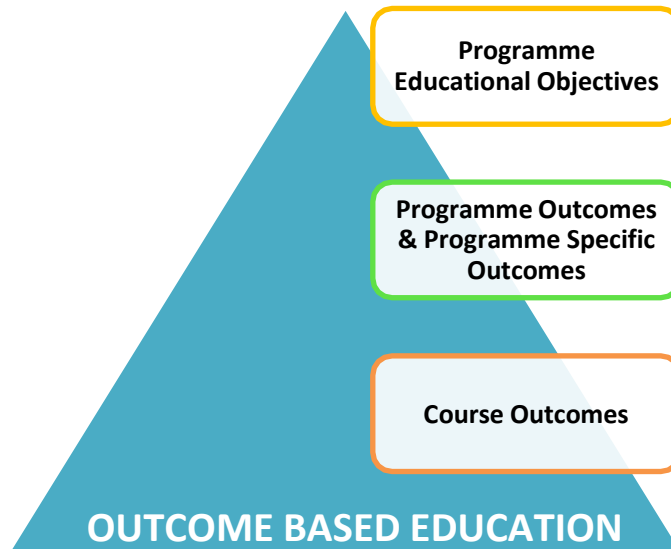- OBLT-Learning/Teaching
- OBA-Assessment

Figure 1: Outcome Based Education

In OBE, the curriculum is carefully constructed by first determining the outcomes, and then designed backwards by:

- Carefully determining authentic assessments (how will we know?)
- Choosing/building relevant learning activities and experiences.
- Selecting appropriate content.

Unique Features of OBE

- OBE enhances the communications among various stakeholders.
- OBE helps in examining the vision and mission of the institution.
- OBE evaluates students' performance effectively.
- OBE helps in mapping the course outcomes and Programme Outcomes for each assessment.

KEY PARAMETERS OF OBE

Course

Course is defined as a theory, practical or theory cum practical subject studied in a semester. For E.g. Mathematics

Programme

Programme 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.Sc. Computer Science

Assessment

Assessment is one or more processes carried out by the institution that identifies, collect, and prepare data to evaluate the achievement of Programme Educational Objectives and programme outcomes.

Attainment

Attainment is the action or fact of achieving a standard result towards the accomplishment of desired goals. Primarily attainment is the standard of academic attainment as observed by test or examination result.

- **Graduate Attributes (GA):** The graduate attributes are exemplars of the attributes expected of a graduate from an accredited programme.

- **Programme Educational Objectives (PEOs):** The Programme Educational Objectives of 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.

- **Programme Outcomes (POs):** Programme 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.

- **Programme Specific Outcomes (PSOs):** 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.

- **Course Outcomes (COs):** Course outcomes are statements that describe significant and essential learning that learners have achieved, and can be reliably demonstrated at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

PROCESS INVOLVED IN OUTCOME BASED EDUCATION

Outcome Based Education (OBE) starts with a clear statement on Knowledge, Skills, and Attitudes that the Graduates will be able to demonstrate . These are stated as Programme Outcomes and Course Outcomes and are related with the Vision, Mission and PEO statements and GA as stated in Washington Accord.
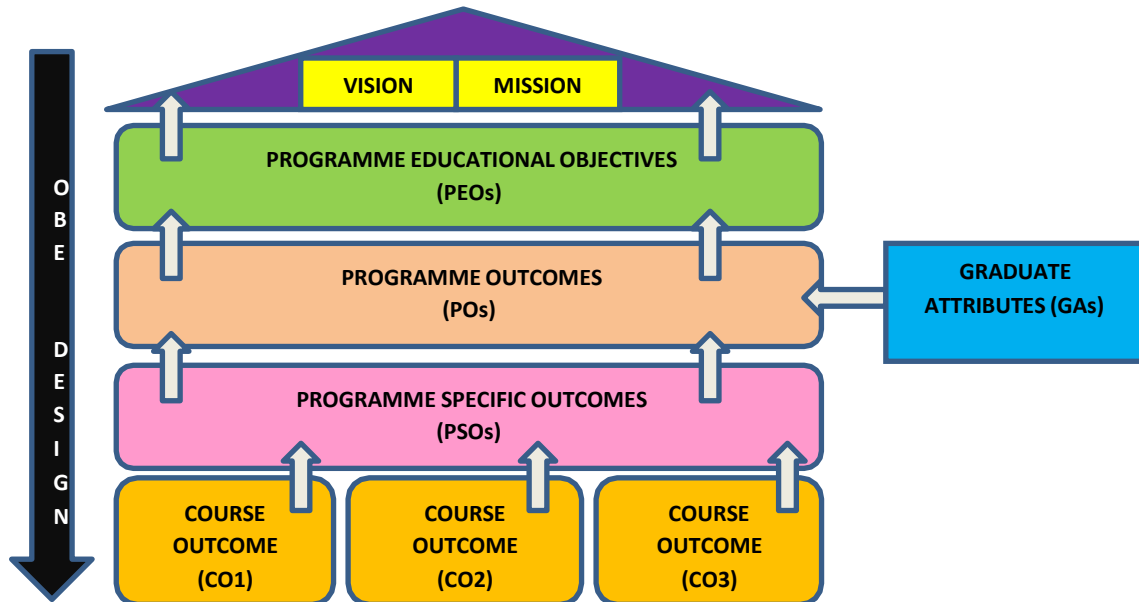

Figure 2: Key Parameters of Outcome Based Education

The OBE process involves the following steps:

1. Statement of measurable GAs, PEOs, POs/PSOs, and COs.
2. Designing appropriate Outcome Based Curriculum.
3. Deliberate Planning of Teaching-Learning Process.
4. Continuous Evaluation using suitable assessment methods and tools at apt time.
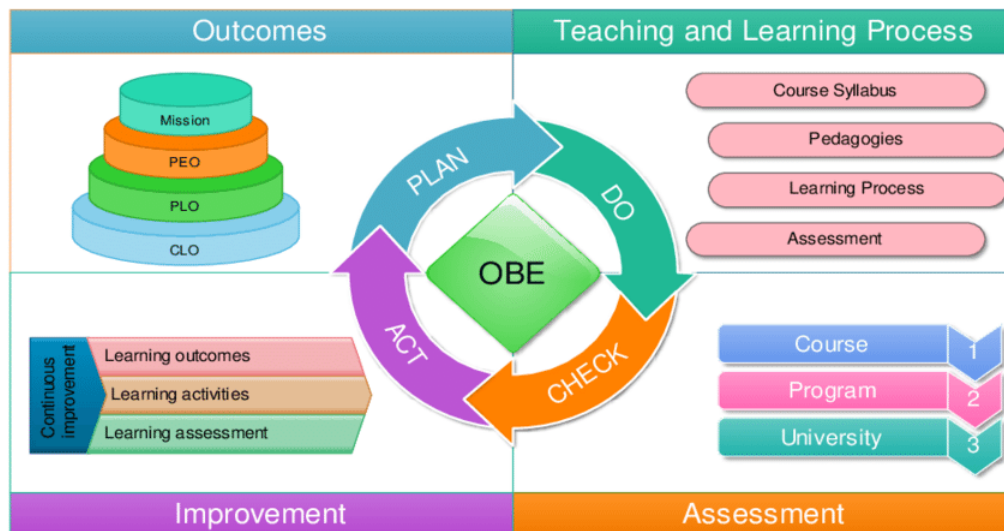
Figure 3: Process involved in Outcome Based Education

IMPLEMENTATION STRATEGY OF OBE

Since OBE focusses on student competency, it concentrates on the outcomes or goals instead of just marks or scores. So the goals which could be a certain number of skills and knowledge that the learner should have at the end of the course. The assessment methods are defined to measure the achievement of these goals. The teachers take the role of being facilitators and mentors. Constructive feedback from the students also helps in reshaping the curriculum.

STEPS

1. Assessment of curriculum and needs
2. Defining outcomes
3. Collaboration and Implementation
4. Defining the role of assessments and results, and measuring success
5. Feedback and continuous evaluation

ACT
- Adjust Design
- Adjust Delivery
- Adjust Assessment

PLAN
- Establish outcomes
- Design learning content
- Build assessments

CHECK
- Analyze assessment data
- Propose improvements

DO
- Deliver content
- Assess learning
- Document

- ☐ Alternate Design
- ☐ Alternate Content Delivery Options
- ☐ Alternate Assessment Options

- ☐ PEOs, POs, PSOs, COs
- ☐ Syllabus
- ☐ Exam, Project, Survey, etc.

- ☐ Surveys, Discussions, Analysis of Feedback from students, industry, alumni, teachers, external examiners, etc.
- ☐ Analysis of Attainment of PEOs, POs, PSO, and COs
- ☐ Proposal enhancements

- ☐ Lecture, Lab, Tutorial, etc.
- ☐ Exam, Test, Quiz, Report, Portfolio, Presentation, etc.
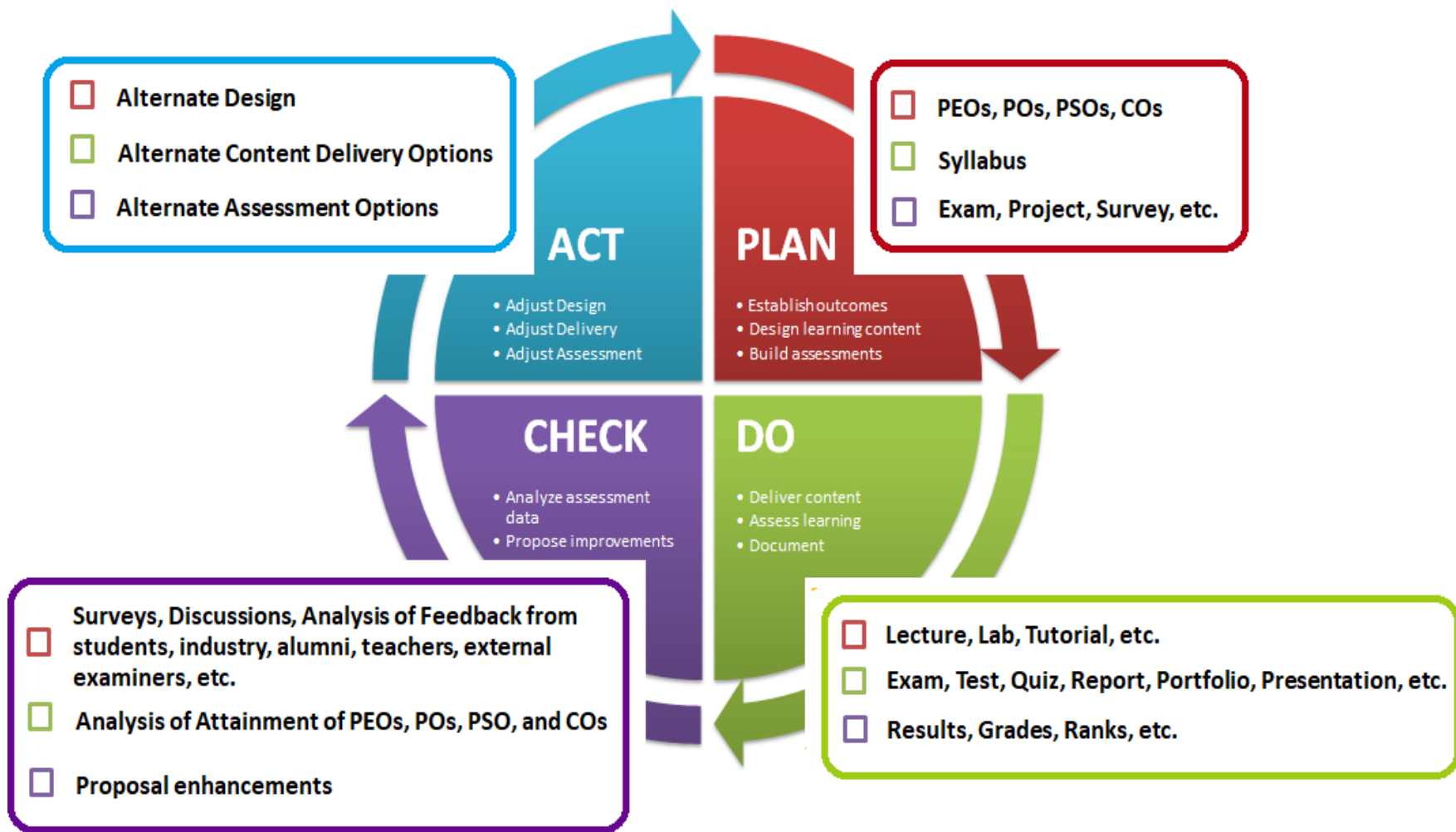- ☐ Results, Grades, Ranks, etc.

Figure 4: Implementation of Outcome Based Education

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GRADUATE ATTRIBUTES

Graduate attributes refer to the skills, knowledge and abilities of the graduating students, beyond disciplinary content knowledge, that are applicable in a range of contexts in their lives. The graduate attributes are essential for employability and hence serve to enhance the development of students' academic, specialist and technical competencies defining a higher education experience and equipping them with transferrable skills that can be applied in different environments. At the successful completion of two years for PG programmes, the graduates of the University will be able to attain the following Graduate Attributes:

- Domain Expertise
- Technical Competency
- Transferrable Skills
- Interdisciplinary Knowledge
- Personality and Personal Growth
- Communication and Information Management
- Critical Thinking and Problem Solving
- Individual and Team Work
- Professional Ethics and Social Values
- Entrepreneurship Qualities
- Environment and Sustainability
- Lifelong Learning

PROGRAMME EDUCATIONAL OBJECTIVES

Programme Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the programme is preparing the graduates to achieve. PEO's are measured around 4-5 years after graduation. PEO's can be measured by a PO-PEO matrix. These may be guided by global and local needs, vision of the institution, long term goals, etc.

Guidelines

- PEOs should be consistent with the mission of the Institution.
- The number of PEOs should be manageable.
- PEOs should be achievable by the programme.
- PEOs should be specific to the programme and not too broad.
- PEOs should be based on the needs of the constituencies.

Evolving PEOs

- The PEOs should evolve through constant feedback from:
    a. Industry, Alumni, Students, Management
    b. Professional Bodies, Faculty, Parents
    c. Data on trends in the profession
- Views regarding the feedbacks received are summarized and acceptable views are identified.
- The PEOs are formulated based on the Accepted Views.

LEVELS OF OUTCOMES

Outcomes are the learning results that the students demonstrate at the end of their learning experiences. Outcomes reflect what students can actually do with what they know and have learned as part of their programme of study.Outcomes include knowledge, skills and attitudes attained after 4 – 5 years of graduation. In OBE, the outcomes for a higher education programmes are defined at three levelsas Programme Outcomes (POs), Programme Specific Outcomes (PSOs) and Course Outcomes (COs).
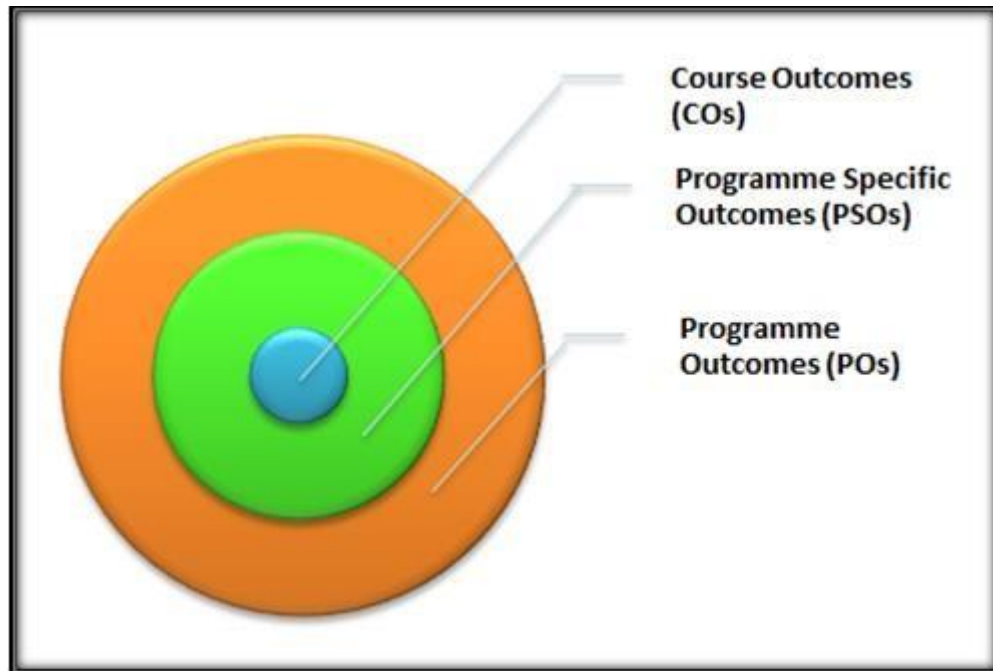
Figure 5: Levels of Outcomes

PROGRAMME OUTCOMES

POs are expected to be aligned closely with Graduate Attributes. POs are also referred to as programme Learning Outcomes (PLOs).

Example: Outcomes formulated for MCA programme
Vision

We intend to impart Knowledge of Computer Applications into the young aspiring graduates who can adapt to the demanding needs of the Information Technology Industry and can contribute to the Research and Development Sector of the Country and the Globe.

Mission

The department strives to educate the underprivileged rural section of young graduates by providing state of the art infrastructure and adapting to the blend of e-Learning with traditional teaching

pedagogy to shape them as industry ready professionals and socially relevant researcher.

Programme Outcomes at Postgraduate Level

Postgraduates will be able to

PO1: Demonstrate intense knowledge in their discipline

PO2: Exhibit specialized skills to plan, analyze and draw conclusions related to their respective field of study in theory and in practice

PO3: Develop expertise in their field of study through projects and research activities

PO4: Prepare themselves to incorporate new technologies in their own discipline and demonstrate excellence in their area of specialization

PO5: Develop social and ethical responsibility in the transfer and management of knowledge.

VII. Programme Educational Objectives (PEOs) of M.C.A

PEO1: To prepare the students to be skilled professionals, innovators or entrepreneurs engaged in technology development and deployment in the industry.

PEO2: To train the students for the industry by imparting sound background in theoretical and applications-oriented courses relevant to the latest trends in the industry.

PEO3: To imbibe the quality of providing solutions and develop system based applications for real time problems in various domains involving technical, managerial, economic and social constraints.

PEO4: To pursue higher studies in computing or related disciplines

PEO5: To become effective teachers by inculcating the taste for teaching and learning.

PEO6: To Comprehend effective documentation and presentations

PEO7: To actively involve in research and development in the industry or academia.

PEO8: To recognize the need for and develop the ability to engage in continuous learning as a computing professional.

Graduate Attributes (GAs) of M.C.A

GA1: Possess strong technical skills

GA2: Problem Solving and Analytical ability

GA3: Passionate in Design, Development and Deployment of Software

GA4: Communication Efficacy

GA5: Adopting to Latest Trends and Technological advancements

GA6: Professionally ethical

GA7: Ability to work in Team

GA8: Adhere Lifelong Learning

GA9: Espouse self-learning abilities

GA10: Create and deliver technical documents and presentations

GA11: Transform into Entrepreneurs, Innovators and Researchers

Program Specific Outcomes (PSOs) of M.C.A

PSO1: Understand and apply the knowledge of computing skills inherited from the course
to abstract and model real time problems.

PSO2: Integrate the problem solving and technical abilities to design and deploy software

PSO3: Identify, scrutinize, adopt and apply modern tools and technologies as per the requirements

PSO4: Realize the importance of working in a team and team building.

PSO5: Able to inculcate ad-hoc learning abilities with communication efficacy.

PEO – PO Mapping

PEO	PO1	PO2	PO3	PO4	PO5	Mean Score
PEO1	3	3	3	3	3	3
PEO2	3	3	3	3	3	3
PEO3	3	3	3	2	2	2.6
PEO4	2	1	2	1	1	1.4
PEO5	2	2	2	1	3	2
PEO6	1	1	2	1	1	1.2
PEO7	3	3	3	1	1	2.2
PEO8	1	1	3	1	3	1.8
Mean Overall Score						2.15
Result						High

High – (2.1 – 3), Medium – (1.1 – 2), Low – (0 – 1)

PO – GA Mapping

PO	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	Mean Score
PO1	3	3	3	2	3	2	1	1	1	2	3	2.2
PO2	3	3	3	1	3	1	1	1	1	1	3	1.9
PO3	3	1	1	1	3	1	1	2	2	2	2	1.8
PO4	1	1	1	3	1	3	3	1	1	1	1	1.6
PO5	1	2	1	3	2	1	1	3	3	2	3	2
Mean Overall Score												2
Result												Medium

High – (2.1 – 3), Medium – (1.1 – 2), Low – (0 – 1)

PEO – GA Mapping

PEO	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	Mean Score
PEO1	3	3	3	2	3	2	2	3	2	2	3	2.5

PEO2	2	2	3	3	2	3	3	2	2	3	2	2.4
PEO3	3	3	2	3	3	3	3	3	3	3	3	2.9
PEO4	3	3	3	3	2	2	3	2	3	3	2	2.6
PEO5	3	2	2	3	3	2	3	3	3	2	2	2.5
PEO6	2	3	3	2	2	2	3	3	3	2	2	2.4
PEO7	3	2	2	2	2	3	3	3	3	2	2	2.4
PEO8	2	3	3	3	3	3	2	3	3	2	2	2.6
										Mean Overall Score		2.5
										Result		High

High – (2.1 – 3), Medium – (1.1 – 2), Low – (0 – 1)

I. PSO – PO Mapping

PSO	PO1	PO2	PO3	PO4	PO5	Mean Score
POS1	3	3	3	3	1	2.6
PSO2	3	3	3	3	1	2.6
POS3	3	3	2	3	1	2.4
PSO4	3	3	3	3	1	2.6
PSO5	3	3	2	2	1	2.2
				Mean Overall Score		2.5
				Result		High

High – (2.1 – 3), Medium – (1.1 – 2), Low – (0 – 1)

PROGRAMME SPECIFIC OUTCOMES

Programme Specific Outcomes (PSOs) are statements that describe what the graduates of a specific academic programme should be able to do. These are Programme Outcomes (POs) defined in specific to the discipline of study.

PG Programme Guidelines

- PSOs must be specific to the particular discipline of an academic programme.
- PSOs must reflect POs.
- **Mapping for the courses**

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	P08	P09	P10
CO1										
CO2										
CO3										
CO4										
CO5										

COURSE OUTCOMES

COs are the statements of knowledge/ skills/ abilities that students are expected to know, understand and perform as a result from their learning experiences in each course. In
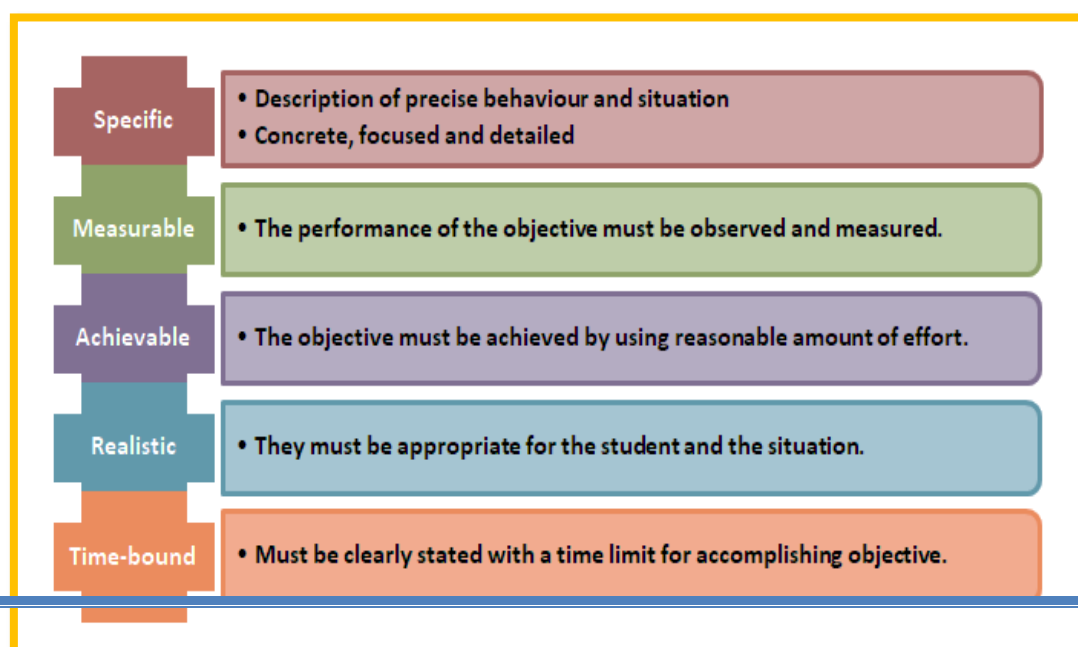
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order to graduate from a programme, students must pass a significant number of required courses (subjects) with at least a minimal proficiency level (often in the form of marks or grades), as set forth by the affiliating university. Usually, a university gives a syllabus that the institution must adhere to. The syllabus specifies the teaching strategy and content for each course. Course Outcomes (COs) are the measurable parameters which evaluate the student performance for each course that the student undertakes in every semester. COs are also referred to as Course Learning Outcomes (CLOs).

Guidelines

- COs should aim to develop higher order skills in each Domain of Learning.
- Typically 4-6 COs are identified per Course.
- The CO statements are defined by considering the course content covered in each module of a course. On average, a typical CO is expected to take between 7-10 lessons in a 40 lesson course.
- Attainment of each CO should lead to attainment of one or more POs.

DEFINING COURSE OUTCOMES

Course Outcomes (COs) are statements clearly describing the meaningful, observable and measurable knowledge, skills and/or dispositions that the students will learn in a particular course – the essential knowledge, abilities, and attitudes that constitute the basic learning needed by a graduate of this course. These are major domain specific outcomes written using action verbs which are specific, measurable, achievable, realistic and time-bound (SMART) and can be demonstrated by students on completion of each course. A well written CO facilitates teachers in measuring the achievement of the CO at the end of each course. It also helps the teachers in designing suitable delivery and assessment methods to achieve the

Specific	• Description of precise behaviour and situation • Concrete, focused and detailed
Measurable	• The performance of the objective must be observed and measured.
Achievable	• The objective must be achieved by using reasonable amount of effort.
Realistic	• They must be appropriate for the student and the situation.
Time-bound	• Must be clearly stated with a time limit for accomplishing objective.

designed COs. COs can be defined and verified by using SMART principle as given below.

<div align="center">**Figure 6: SMART Technique of Defining Learning Outcomes**</div>

There are 3 types of Course Learning Outcomes:

1) **Cognitive Outcomes**: "What will the students know after completing a course?"

2) **Behavioral Outcomes**: "What will the students be able to do after completing a course?"

3) **Affective Outcomes**: "What will the students care about or think after completing this course?"

Well-written learning outcomes involve the following parts:

- Action verb
- Level of achievement
- Subject content
- Condition of performance (if applicable)

GOOD COURSE OUTCOMES

Course Outcomes (COs) are central to a course's curriculum. They articulate to students, faculty, and other stakeholders what students will achieve in each course and how their learning will be measured. Good Course Outcomes use action verbs to specify the demonstrable and measurable knowledge, skills or dispositions possessed by students completing this course. Instead of using vague and not easily observable or measurable verbs or phrases like know, understand, appreciate, be aware of, learn comprehend, or become familiar with, is used .Good COs *employ specific verbs* like, compile, identify, create, plan, revise, analyze, design, select, utilize, apply, demonstrate, prepare, use, compute, discuss, explain, predict, assess, compare, rate, critique, outline, or evaluate.

Mapping of COs and POs
Steps to write a good CO

The primary footstep in writing a good CO is to identify and select the essential, distinct, measurable and demonstrable learning that the students are expected to achieve in a particular course of a programme and under specific programme discipline and that will support or advance the learning outcomes of the department and the institution. For every identified and chosen learning outcome, the following precautions are undertaken:

1. Select an action verb using Bloom's Taxonomy identifying the specific student knowledge, skill or disposition to be demonstrated.

2. Clearly identify the subject content focusing on specific knowledge, skill or disposition that the students are expected to be able to demonstrate.

3. Decide if the CO requires either a level of achievement or a condition of performance. A *level of achievement* identifies how proficient students need to be in a task. A *condition of performance* identifies if students are performing this particular outcome

in a specific context only and hence may not be needed for every CO.

4. Be certain to pair each CO with one or more learning activities that will allow the students to achieve this outcome and permit faculty to measure this achievement.
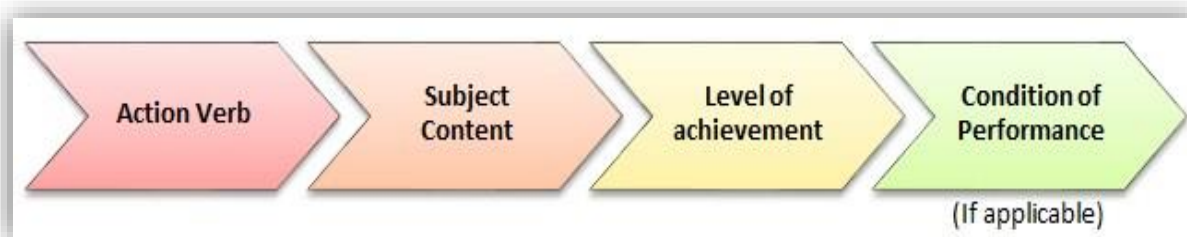

Figure 7: Parts of Good Learning Outcome

Sample Course Objectives and Mapping (Introduction to Java Programming)

CO. No.	CO- Statement	Cognitive Level
CO 1	Discover and Apply various components and technologies used in Java platform	K1,K3
CO 2	Describe, Understand and adapt the basics of JSTL tags and EJB.	K1,K2,K6
CO 3	Apply AWT and Swing components to design GUI	K3,K6
CO 4	Examine and develop Client-Server programs using Socket, RMI and Servlet.	K4,K6
CO 5	Distinguish and Choose the Struts 2 framework for building Java EE applications.	K2,K5
CO 6	Device and Construct a well-structured MVC web application using Servlet and JSP.	K4, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	3	3	2	3	3	3	3	2	2.8
2	3	3	3	3	2	3	3	3	3	2	2.8
3	3	3	3	3	2	3	3	3	3	2	2.8
4	3	3	3	3	2	3	3	3	3	2	2.8
5	3	3	3	3	2	3	3	3	3	2	2.8
6	3	3	3	3	3	3	3	3	3	2	2.8
										Mean Overall Score	2.8
										Result	High

Finally, each learning outcome is defined in the form of statements comprising of the identified action verb and specific skill/knowledge/skill/disposition. The attainment of each CO is adequately paired with appropriate and suitable learning activities and is measured through appropriate assessment methods and tools.

BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

Bloom's Taxonomy is a hierarchical model that categorizes learning objectives into varying levels of complexity (arranged in an order), from basic knowledge and comprehension to advanced evaluation and creation (Bloom, 1956). The taxonomy provides different levels of learning objectives, divided by complexity. Only after a student masters one level of learning goals, through formative assessments, corrective activities, and other enrichment exercises, can they move onto the next level (Guskey, 2005). Bloom's Taxonomy should be applied when creating learning objectives. At the end of the learning process, the goal of Bloom's taxonomy is that a student has sharpened a new skill, level of knowledge, and/or developed a different attitude towards the subject. Also, teachers are able to effectively evaluate this learning on an ongoing basis, as the course moves through each stage of the framework.

Domains of Learning

Bloom's Taxonomy comprises of three learning domains: cognitive, affective, and psychomotor. Within each domain, learning can take place at a number of levels ranging from simple to complex. Designers, trainers, and educators often refer to them as KSA (Knowledge [cognitive], Skills [psychomotor], and Attitudes [affective]). After a learning experience, the learner should possess a new skill, knowledge, and/or attitude.
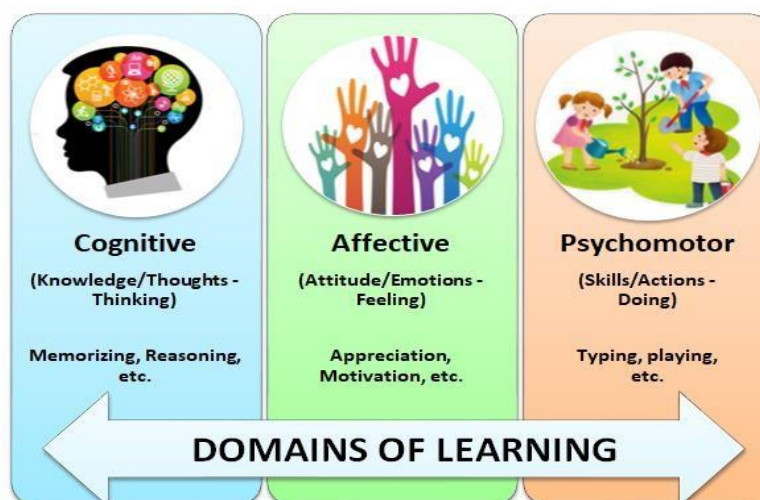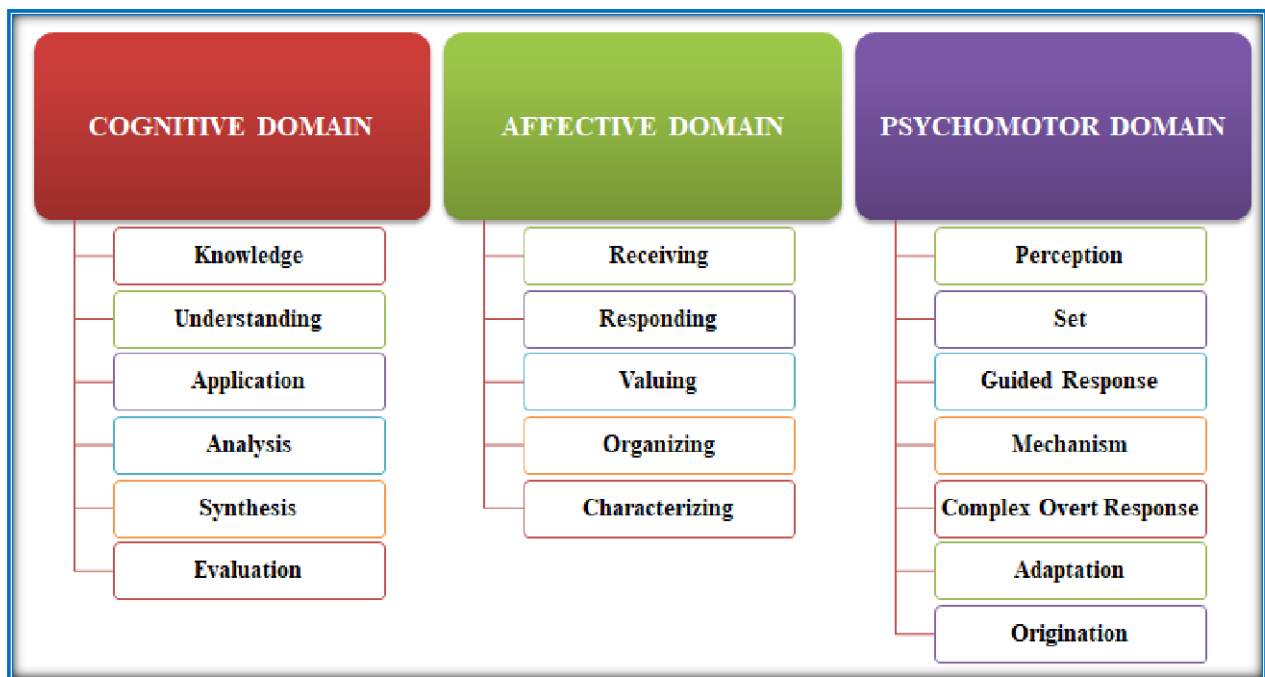

Figure 8: Domains of Learning

Figure 9: Domains of Learning

Bloom's Taxonomy (Cognitive Domain): Original and Revised Versions

Bloom's Taxonomy classifies learning objectives for students, from recalling facts to producing new and original work. The framework elaborated by Bloom and his collaborators consisted of six major categories under cognitive domain: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The categories after Knowledge were presented as "skills and abilities," with the understanding that knowledge was the necessary precondition for putting these skills and abilities into practice.

A group of cognitive psychologists, curriculum theorists and instructional researchers, and testing and assessment specialists published in 2001 a revision of Bloom's Taxonomy with the title: "A Taxonomy for Teaching, Learning, and Assessment". In the revised taxonomy, two dimensions are presented in the cognitive domain: the knowledge dimension and the cognitive dimension. There are four levels on the knowledge dimension: factual, conceptual, procedural, and metacognitive. There are six levels on the cognitive process dimension: remembering, understanding, applying, analyzing, evaluating, and creating. The new taxonomy enables teachers to think more in depth about the content that they are teaching and the objectives they are focusing on within the classroom. It allowed teachers to categorize objectives in a more-multidimensional way and to do so in a manner that allows them to see the complex relationships between knowledge and cognitive processes.

Dimensions of Knowledge

The dimension of knowledge is focused on 'Knowing what'. The knowledge dimension represents a range from concrete (factual) to abstract (metacognitive). Knowledge is characterized under the followingfour dimensions.
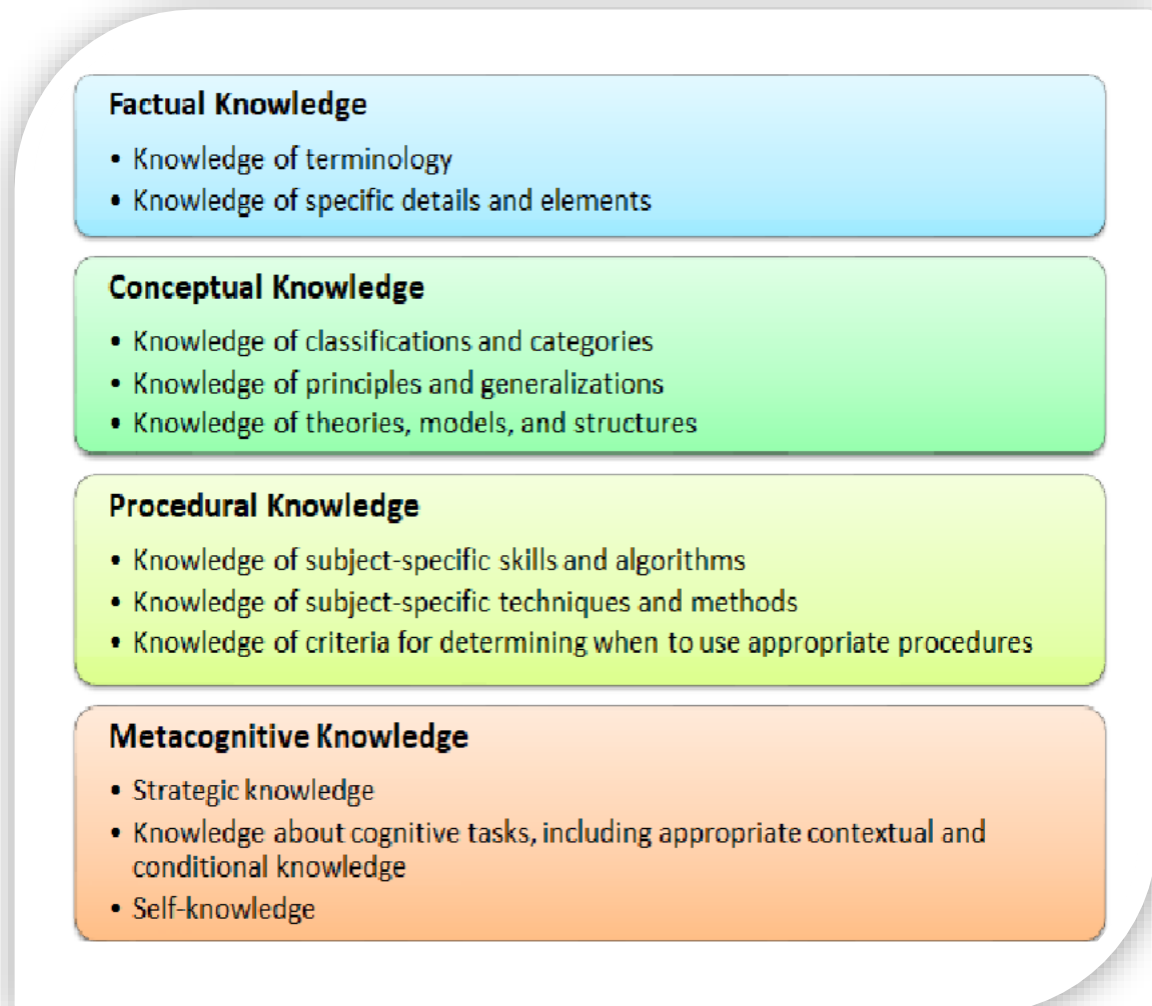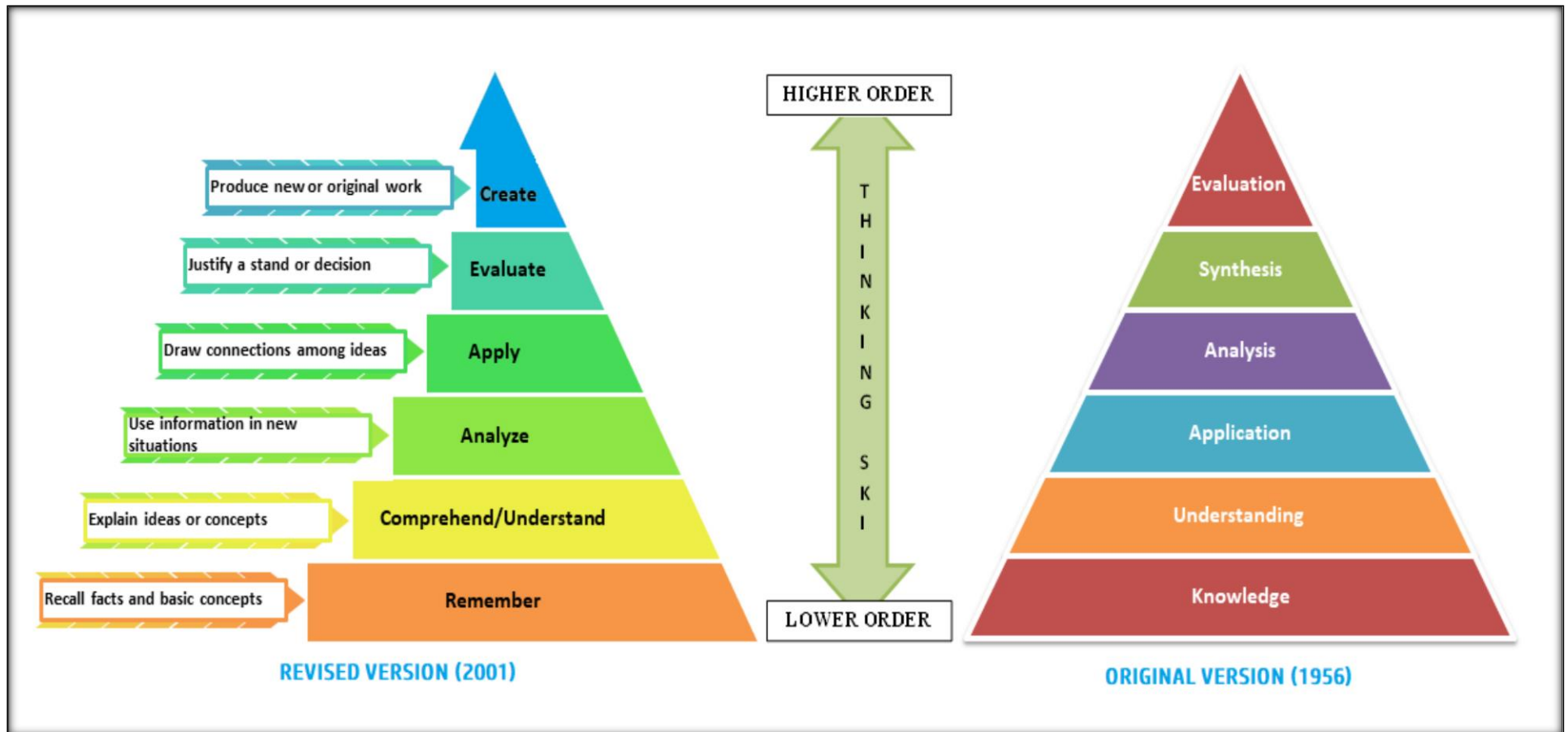
Factual Knowledge
- Knowledge of terminology
- Knowledge of specific details and elements

Conceptual Knowledge
- Knowledge of classifications and categories
- Knowledge of principles and generalizations
- Knowledge of theories, models, and structures

Procedural Knowledge
- Knowledge of subject-specific skills and algorithms
- Knowledge of subject-specific techniques and methods
- Knowledge of criteria for determining when to use appropriate procedures

Metacognitive Knowledge
- Strategic knowledge
- Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge
- Self-knowledge

Figure 10: Dimensions of Knowledge

Figure 11: Revised Bloom's Taxonomy

ACTION VERBS – COGNITIVE DOMAIN

Levels	LOWER ORDER			HIGHER ORDER		
	Remember	**Comprehend**	**Apply**	**Analyze**	**Evaluate**	**Create**
Overview	Recalling basic facts and concepts	Explaining ideas or concepts	Using information in new situations	Drawing connections among ideas	Justifying a stand or decision	Produce new or original work

Action Verbs						
	• Define	• Describe	• Apply	• Analyze	• Assess	• Combine
	• Identify	• Discuss	• Carry out	• Categorize	• Conclude	• Construct
	• Label	• Explain	• Demonstrate	• Compare	• Evaluate	• Design
	• List	• Locate	• Illustrate	• Contrast	• Interpret	• Develop
	• Name	• Paraphrase	• Prepare	• Differentiate	• Justify	• Generate
	• Recall	• Give Example	• Solve	• Discriminate	• Measure	• Plan
	• State	• Translate	• Use	• Outline	• Support	• Propose
	• Choose	• Annotate	• Adapt	• Detect	• Appraise	• Create/Compile
	• Enumerate	• Classify	• Advise	• Diagnose	• Argue	• Compose
	• Find	• Convert	• Build	• Diagram	• Critique	• Discover
	• Group	• Exemplify	• Change	• Dissect	• Debate	• Expand
	• Match	• Generalize	• Choose	• Distinguish	• Decide	• Formulate
	• Reproduce	• Infer	• Compute	• Examine	• Deduce	• Improve
	• Sort	• Map	• Customize	• Separate	• Defend	• Invent
	• Recognize	• Organize	• Dramatize	• Simplify	• Determine	• Integrate
		• Relate	• Employ	• Survey	• Disprove	• Manage
		• Select	• Implement	• Test for	• Estimate	• Prepare
		• Show	• Manipulate	• Trace	• Forecast	• Produce
		• Summarize	• Modify/Alter	• Correlate	• Judge	• Synthesize
		• Translate	• Investigate			

	• Restate • Extrapolate				

ACTION VERBS – AFFECTIVE DOMAIN

Levels	LOWER ORDER		HIGHER ORDER		
	Receiving	**Responding**	**Valuing**	**Organization**	**Internalizing**
Overview	Selective attention to stimuli	Responding to stimuli	Attaching value or worth to something	Conceptualizing the value and resolving the	Integrating the value into a value system

				conflict between it and other values	that controls behavior
Action Verbs	• Accept • Acknowledge • Be aware • Listen • Notice • Pay attention • Tolerate	• Agree to • Answer freely • Assist • Care for • Communicate • Comply • Confirm • Consent • Contribute • Cooperate • Follow • Obey • Participate willingly • Read voluntarily • Respond • Visit • Volunteer	• Adopt • Assume responsibility • Behave according to • Choose • Commit • Desire • Exhibit loyalty • Express • Initiate • Prefer • Seek • Show concern • Use resources to	• Adapt • Adjust • Arrange • Balance • Classify • Conceptualize • Formulate • Group • Organize • Rank • Theorize	• Act upon • Advocate • Defend • Exemplify • Influence • Justify behavior • Maintain • Serve • Support

ACTION VERBS – PSYCHOMOTOR DOMAIN

Levels	LOWER ORDER		HIGHER ORDER				
	Perception	Set	Guided Response	Mechanism	Complete Overt Response	Adaption	Origination
Overview	Senses cues that guide motor activity	Mental, emotional and physical readiness to act	Imitation and practice of skills often in discrete steps	Performing acts with increasing efficiency, confidence and proficiency	Automatic performance	Adapting skill sets to meet a problem situation	Creating new patterns for specific situations.

Action Verbs	• Detect • Hear • Listen • Observe • Perceive • Recognize • See • Sense • Smell • Taste • View • Watch	• Achieve a posture • Assume a body stance • Establish a body position • Place hands, arms, etc. • Position the body • Sit • Stand • Station	• Copy • Duplicate • Imitate • Manipulate with guidance • Operate under supervision • Practice • Repeat • try	• Complete with confidence • Conduct • Demonstrate • Execute • Improve efficiency • Increase speed • Make • Pace • Produce • Show dexterity	• Act habitually • Advance with assurance • Control • Direct • Excel • Guide • Maintain efficiency • Manage • Master • Organize • Perfect • Perform automatically • Proceed	

Sample Assessment Pattern Based on Bloom's Taxonomy

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100)
	I CA (50)	II CA (50)	Marks Allotment
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

ATTAINMENT OF OUTCOMES AND OBJECTIVES

OBE organizes the entire educational system towards what are considered essential for the learners to successfully do at the end of their learning experiences. By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities, and

assessments should all help students achieve the specified outcomes.

- The attainment of COs of all the courses of a programme correlates to the attainment of the respective POs & PSOs.
- The final attainment levels of POs and PSOs for a batch of students of a branch in all the three years (for UG programme) or two years (for PG programme) indicate the effectiveness of the programme implemented.
- As POs are mainly formulated on the basis of GAs, achievement of POs would lead to achievement of GAs by pass outs.
- Achievement of POs and additional training/work for about four to five years after graduation would lead to achievement of PEOs.

The course outcomes are attained through the following instructional activities:

- Projects
- Tutorials
- Laboratory Experiments
- Field work
- Discussions
- Lectures
- Portfolios
- Educational Tours
- Assignment
- Quiz
- Log Book
- Site Visits
- Industrial Training
- Demonstration
- Presentation
- Case study
- Practical
- Debates

MEASUREMENT OF OUTCOME ATTAINMENT

For OBE implementation, initially it is necessary that the desired or defined outcomes are determined and then according to defined outcomes, programme curriculum, teaching and learning methodology and supporting facilities are designed. During the course of the programme, various measurement methods are used to measure the attainment of outcomes. The assessment of outcome attainment largely depends on the student's performance output or marks obtained in final theory and practical examination, test, and submission of assignments which indicates students learning achievements. Therefore, it is necessary and important to carry out a proper attainment method in order to measure student learning achievement and to predict the student's performance in future.

Methods of Assessment of Learning Outcomes

There are different ways to assess student learning. In this section, we present the different types of assessment approaches available and the different frame works to interpret the results.

- Continuous Internal Assessment (CIA)
- Alternate Assessment Tools (AAT)
- Semester End Examination (SEE)
- Laboratory and Project work
- Course exit survey
- Programme exit survey
- Alumni survey
- Employer survey
- Course expert committee
- Programme Assessment and Quality Improvement Committee (PAQIC)
- Department Advisory Board (DAB)
- Faculty meetings
- Professional societies

ASSESSMENT OF OUTCOMES

All (Direct + Indirect) CO Assessment Tools = PO Direct Assessment Tools

- The assessment process of COs, PSOs and POs can be direct or indirect.
- The direct assessment will be done through interim assessment by conducting continuous internal exam and semester end exams.
- The indirect assessment on the other hand could be done through student's programme exit questionnaire, alumni survey and employment survey.

Direct Assessment Tools	Indirect Assessment Tools
- Class Test - Internal Assessment - Assignments - Practical Examination - Mock Test - Seminar/Presentations - Mini Project - Revision Examinations - Semester End Examinations	- Student Feedback Survey - Alumni Feedback Survey - Teachers Feedback Survey - Employer Feedback Survey

CO ATTAINMENT ASSESSMENT

Direct Assessment (Component-wise)

S. No.	Course Type	Internal Components	Marks	Total
1	Theory	2 CA Tests	30	**50**
		Online Test / Quiz	5	
		*Other Components	15	
		Paper Work		
		Problem Solving / Group Discussion / Discussion Forum		
		Technical reports		
		Application Development		
		Seminar		
		Demonstration		
		Open Book Assignment		
2	Theory Combined Practical	2 CA Tests	30	**50**
		Online Test / Quiz	5	
		Paper Work	5	
		Demonstration/Technical Report		

		Lab Exercises	10	
3	Practicals	Assessment of Lab Exercises	30	**50**
		Record Work	10	
		Test	10	
4	Pure Practicals	Assessment of Lab Exercises	30	**50**
		Application Development	20	

Indirect Assessment

S.No.	Tool	Process	Frequency
1	Student feedback survey	• Taken at the end of every academic year • Providing feedback analysis reports to the HoDs, BoS members and AOs • Remedial actions	Once in an academic year
2	Alumni feedback survey		Once in an academic year
3	Teachers feedback survey		Once in an academic year
4	Employer feedback survey		Once in an academic year

PO ATTAINMENT ASSESSMENT

	Assessment	Tools	Weight
POs/PSOs Attainment	Direct Assessment	CO attainment of courses	80%
	Indirect Assessment	Student Feedback Survey	20%
		Alumni Feedback Survey	
		Employer Feedback Survey	
		Teacher Feedback Survey	
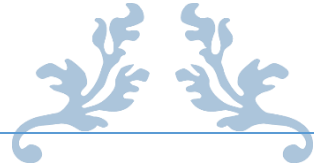
OBE – ATTAINMENT

ATTAINMENT OF COURSE

Course outcomes (CO) are framed to specify what will the student gain in terms of knowledge and skill by learning the course. The outcomes are measurable and observable which are used to determine the attainment level of the course. Programme outcomes (PO) projects the status of accomplishments after completing the programme. The PO attainment is calculated based on the attainment levels of courses offered under the programme.

Course correlation matrix explained below gives the information about the relationship between Course Outcomes and Programme Outcomes. The mapping of PO and CO correlates whether the course outcomes matches with programme outcomes which finally reflects the success of the programme.

Verbs	Bloom levels
Remember	K1
Understanding	K2
Apply	K3
Analyse	K4
Evaluate	K5
Create	K6

Type	PO	Pos action Verbs	Pos Blooms Levels	COs Bloom's Level(s)
Technical skills	PO1	Apply	K3	K1 to K4 »»» Theory Courses, K1 to K5 »»» Laboratory Courses, K1to K6 »»» Mini Project and Major Project (Assign 1 for K1, 2 for K2….6 for K6)
	PO2	Understanding	K2	
		Create	K6	
		Analyze	K4	
	PO3	Design	K3, K6	
		Develop	K3, K6	
	PO4	Analyze	K4	
		Interpret	K2, K3	
		Design	K6	
	PO5	Create	K6	
		Select	K1, K2, K6	
		Apply	K3	
	PO6	Apply	K3	
		Assess	K5	
Transferable Skills	PO7	THUMB RULE If K1 Action Verbs of a CO »»» Correlates with any of PO7 to PO12 »»» then assign 1 If L2 to L3 Action Verbs of a CO »»» Correlates with any		
	PO8			
	PO9			
	PO10			
	PO11			

Note:

- The first six Pos are purely technical in nature, while the other Pos are transferable skills.
- The CO level is set between 1 and 4 for the theory courses. The CO level is set between 1 and 5 for the laboratory courses. The CO level is extended upto 6th level only for mini projects and major projects.
- For a given course, the course faculty member has to involve all other faculty members who teach that course and ask them to come up with the CO-PO mapping. The course faculty member has to take the average value of all of these CO- PO mappings and finalize the values, or the course faculty member can go with what the majority of the faculty members prefer. While matching COs with non-technical Pos, correlate the action verbs used in the COs with the thumb rule given in the table and map the values.

Procedure followed while assigning the values by mapping COs to Pos.

- Select action verbs for a CO from different Bloom's levels based on the importance ofthe particular CO for the given course.
- Stick on to single action verbs while composing COs and use for multiple action verbsif the need arises.
- Values to CO-PO (technical Pos in particular) matrix are assigned by
  - ❖ Judging the importance of the particular CO in relation to the Pos. If the CO matches strongly with a particular PO criterion then 3 is assigned, if it matches moderately then 2 is assigned or less than 1 is assigned else marked with " – " symbol.
  - ❖ If an action verb used in a CO is repeated at multiple Bloom's levels, then reconsider which Bloom's level is the best fit for that action verb.
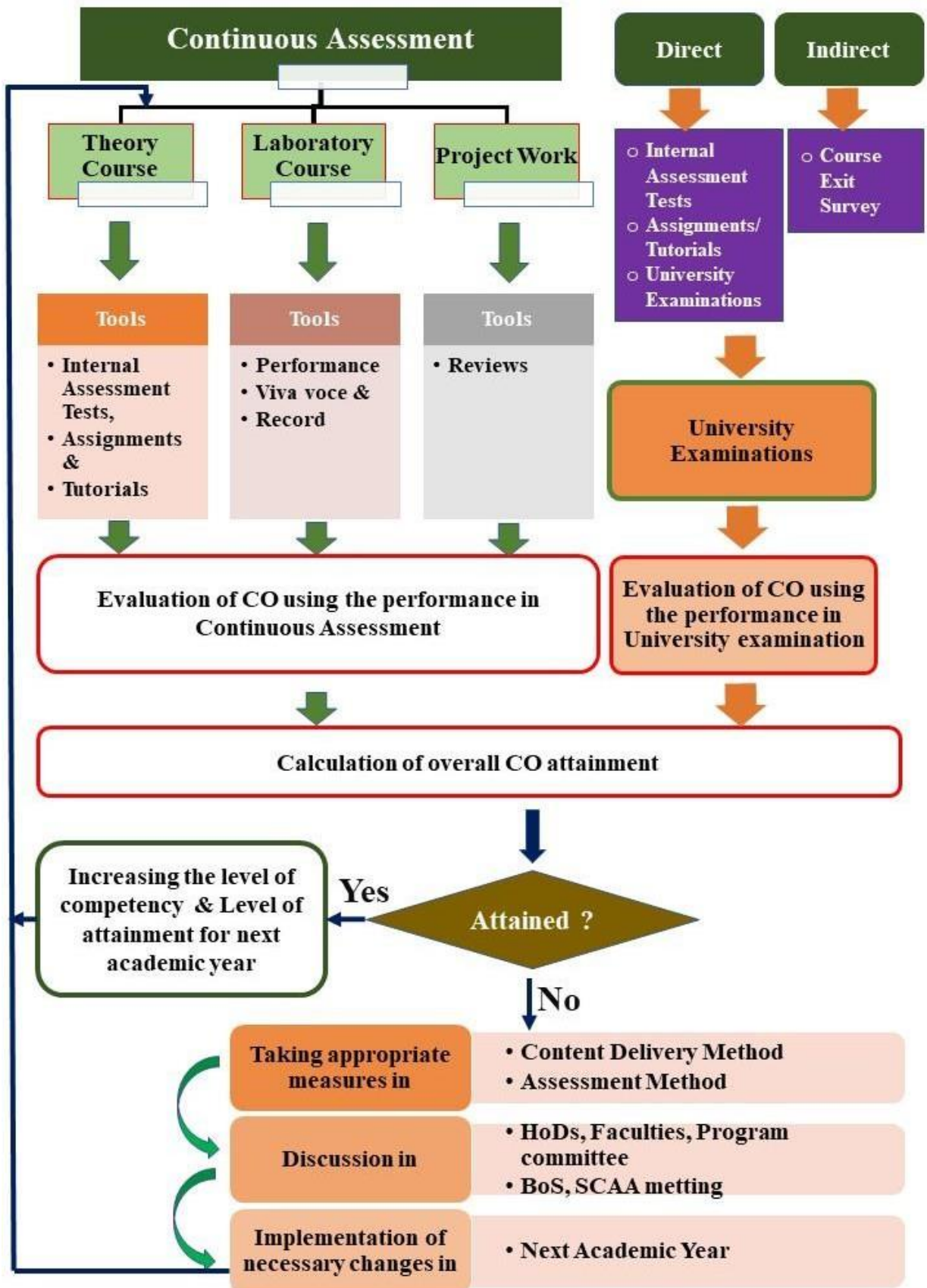
Figure 1. Process for CO Attainment

Direct Assessment:

Evaluation Methods	Process
Internal Assessment Tests	**Three Internal Assessment Tests are conducted per semester to evaluate the attainment of course outcomes. Each question is mapped with COs and blooms level.**
Assignments & Tutorials	**The tutorials and assignments are given to the students based on the subject nature. For four credit papers tutorials are mandatory. Tutorial and Assignment sheets are prepared by the faculty member with COs and levels.**
Continuous Assessment & Model Exam (Laboratory Course)	**The evaluation criteria for each experiment are based on performance, viva-voce and record mark. The attainment of COs is calculated through continuous assessment and model practical performance.**
Project Reviews	**Three reviews are conducted periodically to monitor and evaluate the progress of the project using project rubrics. Viva-Voce is conducted at the end of the semester as per College norms.**
Endsemester Examination	**At the end of each semester, final examination is conducted for Theory and Laboratory courses by various departments, in which question paper covers the entire syllabus and all the Cos are covered in the question papers.**

Attainment Level:

1	• 60% of Students ≥ 60 Marks
2	• 70% of Students ≥ 60 Marks
3	• 80% of Students ≥ 60 Marks
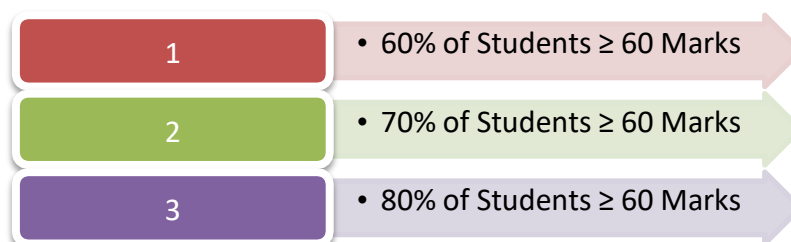
Theory courses:

For each theory course, faculty member calculates the course outcome attainment using Endsemster Examination and Internal Assessment Test. The attainment level will be calculated based on the average performance levels of both end semseter Examination and Internal Assessment Test. The evaluation process of Internal Assessment Tests/Assignments/Tutorials/Group Discussion is counted for 40% and the remaining 60% will be given for end semester examination. Based on the level of CO attainment, the faculty member will decide whether to increase the competency level or change the content delivery method, assessment methods to improve attainment level for the course.

	Assessment Tool	Weightage	Frequency
CO Attainment	Internal Assessment Tests	40%	**Thrice in a Semester**
	Endsemester Examination	**60%**	**Once in a Semester**

Laboratory Courses:

For laboratory courses, the course outcome will be calculated based on performance, viva-voce, record work and model practical examination with the weightage of 40% for Continuous Internal Assessment and 60 % weightage for Practical Examination. Based on the CO attainment level, the faculty member will decide whether to increase the competency level or enhance the practical knowledge of the students in order to improve attainment level for the laboratory course.

	Assessment Tool	Weightage	Frequency
CO Attainment	Continuous Internal Assessment	40%	**Every Week**
	Practical Examination	**60%**	**Once in a Semester**

Project Work Assessment:

For project work, Continuous Internal Assessment is based on the performance in the three reviews. The Course Attainment is calculated based on the three reviews and project Viva voce.

- Project review is conducted every month to review the progress of the project and the second review will be conducted in the presence of an industry expert.
- Suggestions are given to the students for their continuous update and improvement.
- Evaluation of each review is based on the parameters discussed in teaching learning process.

The faculty member will decide the competency level and attainment level for project work considering the average performance level of the students.

	Assessment Tool	Weightage	Frequency
Continuous Assessment	Reviews	40%	**Every Month**
Assessment	**Viva-Voce**	**60%**	**Once in a Semester**

CO Attainment Calculation:

The course outcomes for all the courses are calculated in terms of percentage using the formula.

$$COx \text{ in } \% = \frac{\text{Marks obtained by the students in COx}}{\text{Maximum Marks alloted in COx}} \times 100$$

Where, x= [1 to N], N= Number of COs.

Each course outcome is calculated for all the students based on marks obtained by the students.

$$COx \text{ Attainment in } \% = \frac{no. of \text{ Students scored more than or equal to } 60\% \text{ of Marks in } COx}{no. of \text{ Students}} \times 100$$

Where, x= [1 to N], N= Number of Course Outcomes

COx Attainment Level	3	80% of the Students scoring more than or equal to 60% ofMarks in Cox
	2	70% of the Students scoring more than or equal to 60% ofMarks in Cox
	1	60% of the Students scoring more than or equal to 60% ofMarks in Cox

After calculating the attainment levels of each COs from the performance of Internal Assessment Test 1, 2 & 3, the attainment level of Internal Assessment Test is calculated with ratio of sum of all COs attained by total number of COs as shown below:

$$\text{IAT Attainment Level} = \frac{\text{Sum of all COs attained by students}}{\text{Total Number of COs}}$$

Based on university grade, the attainment level of COs is calculated. The attainment level is decided based on the following criteria.

University Attainment Level	3	80% of the Students scoring more than or equal to 50% of Marks inUniversity Exam
	2	70% of the Students scoring more than or equal to 50% of Marks in end semester Exam
	1	60% of the Students scoring more than or equal to 50% of Marks in end semester Exam

Overall CO Attainment:

The Overall Attainment for a course is sum of 40% of Internal Assesment Test Attainment Level and 60% of Attainment Level.

$$\text{Overall CO Attainment} = (\ \underline{\frac{\sum^{n}}{\quad}}\ \textit{Where n= number of course outcome.}$$

Sample Calculation:

$$\text{COx in \%} = \frac{\text{Marks obtained by the students in COx}}{\text{Maximum Marks alloted in COx}} \times 100$$

Where, x= [1 to N], N= Number of COs

Reg. No of the student: 953615106001	$CO1 \text{ in } \% = \dfrac{11.5}{18} \times 100 = 63.88\%$ $CO2 \text{ in } \% = \dfrac{28}{32} \times 100 = 87.50\%$ $CO3 \text{ in } \% = \dfrac{12}{18} \times 100 = 66.67\%$ $CO4 \text{ in } \% = \dfrac{44.5}{65} \times 100 = 68.46\%$ $CO5 \text{ in } \% = \dfrac{9.5}{17} \times 100 = 55.88\%$

Reg. No of the student: 953615106005	$CO1$ in % $= \dfrac{29.5}{33} \times 100 = 89.39\%$ $CO2$ in % $= \dfrac{16}{17} \times 100 = 94.12\%$ $CO3$ in % $= \dfrac{16}{18} \times 100 = 88.89\%$ $CO4$ in % $= \dfrac{64}{65} \times 100 = 98.46\%$ $CO5$ in % $= \dfrac{17}{17} \times 100 = 100\%$
Reg. No of the student: 953615106007	$CO1$ in % $= \dfrac{12.5}{18} \times 100 = 69.44\%$ $CO2$ in % $= \dfrac{26.5}{32} \times 100 = 82.81\%$ $CO3$ in % $= \dfrac{24}{33} \times 100 = 72.73\%$ $CO4$ in % $= \dfrac{47.5}{50} \times 100 = 95\%$ $CO5$ in % $= \dfrac{17}{17} \times 100 = 100\%$
Reg. No of the student: 953615106062	$CO1$ in % $= \dfrac{30}{33} \times 100 = 90.91\%$ $CO2$ in % $= \dfrac{17}{17} \times 100 = 100\%$ $CO3$ in % $= \dfrac{18}{18} \times 100 = 100\%$ $CO4$ in % $= \dfrac{45.5}{50} \times 100 = 91\%$ $CO5$ in % $= \dfrac{31}{32} \times 100 = 96.87\%$

After calculating each course outcomes in terms of percentage, the attainment level of the course is shown below table.

CO1	1	60% of Students scored more than or equal to 60 Marks
CO2	2	70% of Students scored more than or equal to 60 Marks
CO3	2	70% of Students scored more than or equal to 60 Marks
CO4	3	80% of Students scored more than or equal to 60 Marks
CO5	2	70% of Students scored more than or equal to 60 Marks

Internal Attainment is calculated as follows:

$$\text{IAT Attainment Level} = \frac{CO1 + CO2 + CO3 + CO4 + CO5}{5}$$

$$\text{IAT Attainment Level} = \frac{1 + 2 + 2 + 3 + 2}{5} = 2$$

The Attainment is calculated as follows:

The attainment level can be calculated as follows:

Attainment level	1	60% of Students scored more than or equal to 50 Marks
	2	70% of Students scored more than or equal to 50 Marks
	3	80% of Students scored more than or equal to 50 Marks

In this subject 96.36 % of the students scored more than or equal to 50% of the mark in examination, so the Attainment Level is 3.

The Overall Attainment for the course is calculated as follows.

$$\text{Overall CO Attainment} = \left(\frac{\sum_{i=1}^{n} CO_i}{n} \text{ X } 0.4 \right) + (UA \text{ X } 0.6)$$

Where n= number of course outcome.

Overall CO Attainment = (0.4 × 2) + (0.6×3) = 2.6

Overall CO Attainment = 2.6

1.2 Record the attainment of Course Outcomes of all courses with respect to set attainment levels

The attainment level for each course is decided by the respective faculty member. The attainment of COs for all subjects from I year, II year, III year and IV year for the batch 2013-2017, 2014-2018, 2015-2019 and 2016-2020 are assessed by having 60% weightage for end semester examination and 40% weightage to internal assessment tests.

Set Attainment Level Calculation:
- The set attainment level for the first batch (2013-2017) has been fixed as 1.5 for theory courses and 2 for Laboratory courses/Project.
- The set attainment level for the batch 2014-2018 has been fixed by taking average grade point analysis value of the end semester examinations obtained by the 2013-2017 batch students.
- The set attainment level for the batch 2015-2019 has been fixed by taking average value of average grade point analysis value of end semester examination obtained by the previous two batch students.
- The set attainment level for the batch 2016-2020 has been fixed by taking average value of average grade point analysis value of end semester examination obtained by the previous three batch students.

The table 1 shows the methodology Target attainments (Set Attainment Level) for all the courses.

Batch	Target Attainment
2013-2017 (AGPA₁)	**1.5 for Theory Courses & 2 for Laboratory Courses/Projects**
2014-2018 (AGPA₂)	$AGPA_1 \times 0.3$
2015-2019 (AGPA₃)	$\left(\dfrac{AGPA_1 + AGPA_2}{2}\right) \times 0.3$
2016 - 2020	$\left(\dfrac{AGPA_1 + AGPA_2 + AGPA_3}{3}\right) \times 0.3$

Table 2 Targets for Course outcomes

For measuring the attainment of Program Outcomes and Program Specific Outcomes various tools are used. The process for measuring the attainment of each PO & PSO is described in Figure 2.
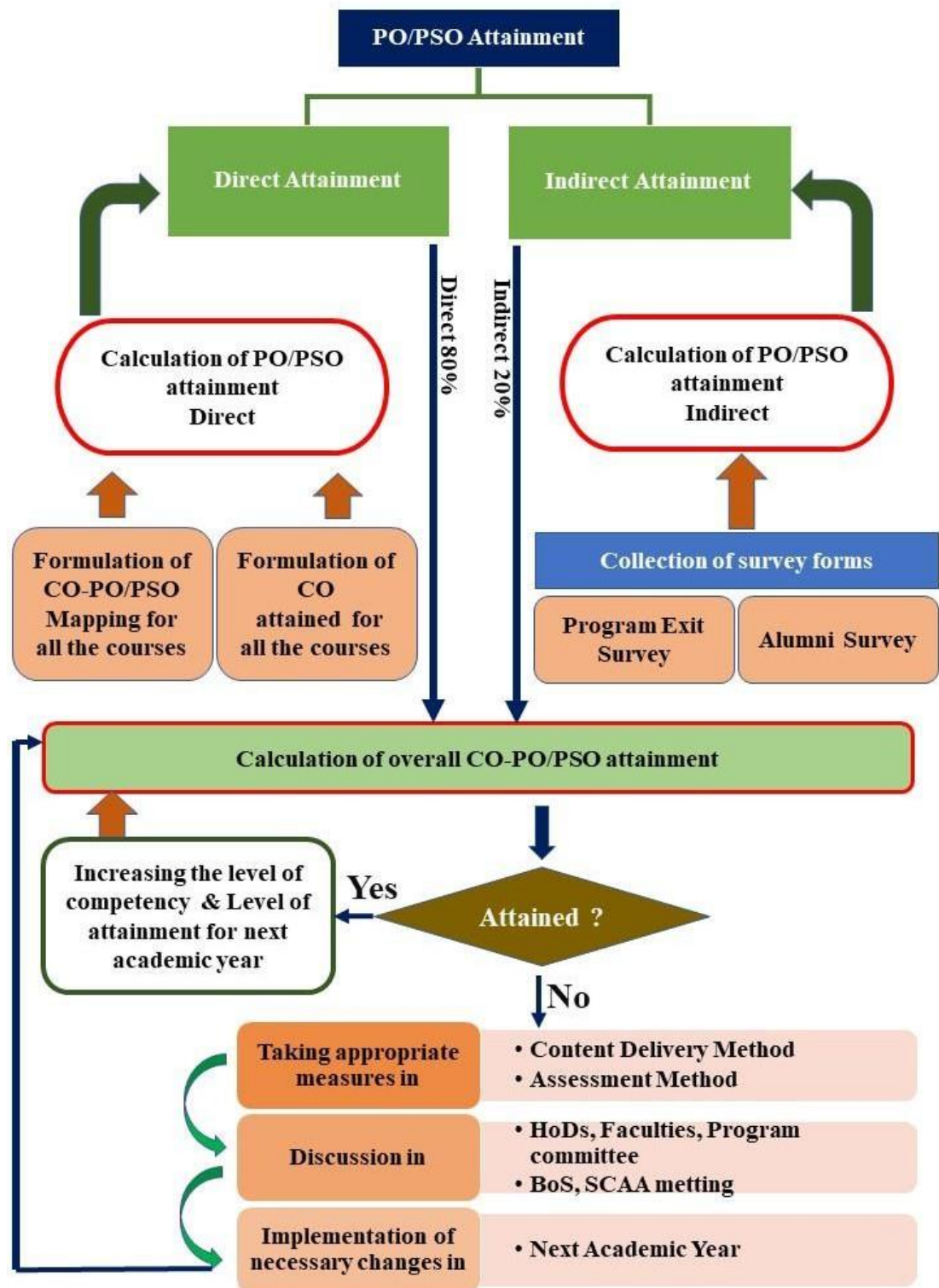
Figure 2. Process for PO/PSO Attainment

PO/PSO Assessment Tools:

Evaluation of attainment of POs and PSOs is based on direct and indirect assessment tools. Direct assessment of POs and PSOs is based on students' performance in Continuous Assessments and end semester Examination. Indirect assessment is based on Program Exit Survey, Alumni Survey and Course Exit Survey (Theory and Practical).

Direct Assessment:

Using Program Outcomes prescribed by NBA, the faculty member evaluates the Program Outcomes and Program Specific Outcomes through Internal Assessment Tests, Assignments / Tutorial and Group Discussion. PO will be evaluated by the CO-PO Mapping with the attainment value for each course. For each course, every faculty member decides the competency level and attainment level.

The following table 3 shows the tools and process for direct PO attainment.

PO Attainment	Tools	Process
Direct (CO Attainment)	• Internal Assessment Test • Assignments • Tutorials • Online Quiz • End semester Examination	• Assignments / Tutorials / online quizzes are given periodically for the entire course to attain the specific POs. • Three Internal Assessment Tests are conducted per semester to evaluate the student performance. • End semster Examination is conducted once in a semester
	• Performance • Viva Voce • Record • Presentation • Group Discussion	• Student Contribution in laboratory is evaluated based on the performance, Viva Voce, Presentation and Record Work. • Model Practical examination is conducted for 100 marks for a duration of 3 hours. • End semester Examination is conducted once in a semester
	• Project Reviews	• Students are divided into batches. Each batch consists of three to four students. • Supervisors are allotted for each group. • Zeroth reviews are conducted for the students to identify the area of project. • Three reviews are conducted periodically to monitor and evaluate the progress of the project. • Viva-Voce is conducted at the end of the semester .

Table 3 Direct Assessment

Course level PO & PSO Attainment Calculation:

The PO & PSO attainment for the course is calculated using the following formula.

$$CO\ Attainment\ Ratio\ of\ C(x) = \frac{CO\ Attainment\ of\ C(x)}{3(Maximum\ attainment\ Value)}$$

Where, x= [1 to N], N= Number of Courses.

$$POm\ Attainment\ of\ c(x) = CO\ Attainment\ Ratio\ of\ C(x)\ X\ POm\ Mapping\ Value\ of\ Course(x)$$

$$Where,\ m= [1\ to\ 12]$$

$$PSOm\ Attainment\ of\ c(\text{x})$$
$$= CO\ Attainment\ Ratio\ of\ C(x)\ X\ PSOm\ Mapping\ Value\ of\ Course(x)$$
$$Where,\ m= [1\ to\ M],\ M= Number\ of\ Program\ Specific\ Outcomes.$$

Program level PO & PSO Direct Attainment Calculation:

The PO & PSO attainment for Program is calculated using the following formula.

$$POm\ Direct\ Attainment = \frac{\sum_{i=1}^{x}\ POm\ Attainment\ of\ c(i)}{x}$$

$$Where,\ m=Program\ Outcomes\ varies\ from\ 1\ to\ 12$$
$$x=Number\ of\ Courses\ mapped\ with\ POm$$

$$PSOm\ Direct\ Attainment = \frac{\sum_{i=1}^{x}\ PSOm\ Attainment\ of\ c(i)}{x}$$

$$Where,\ m=Program\ Specific\ Outcomes\ varies\ from\ 1\ to\ 4$$
$$x=Number\ of\ Courses\ mapped\ with\ PSOm$$

Indirect Assessment:

The following tools are used to assess the indirect assessment of attainment of COs, POs and PSOs. The assessment tools listed in table 3.3.1.2 are used for both CO, PO – PSO attainment calculation.

S.No.	Tools used for Assessment processes	Batch 2013-17	Batch 2014-18	Batch 2015-19	Batch 2016-20
POs, PSOs Indirect Assessment Tools					
1	Program Exit Survey	-	✓	✓	✓
2	Alumni Survey	✓	✓	✓	✓
CO Attainment Indirect Assessment Tool					
3	Course Exit Survey	-	-	-	✓

Table 4 Indirect Assessment Tools

Course Exit Survey (Theory & Practical):

The course exit survey is process of collecting reviews on each course from the students at the end of each semester. It helps to improve the overall aspect of the course in future semesters. The survey covers the overall view about teaching and learning of the respective course. The survey form reveals the following attributes

- Course Content- Quality of the content provided, incorporation of Outcome Based Education
- Course Delivery- Experience about the teaching methodologies, ICT tools, NPTEL resource utilization
- Course Assessment- Methodology of evaluation, feedbacks on assignments and tutorials
- General suggestions for improvement

Program Exit Survey:

It is a process of collecting satisfaction survey on the quality of education from the perspective of graduating students upon the completion of their program. Program Exit Survey is structured with 5 likert scale questions. The survey helps in identifying

- Perception on the overall quality of teaching, learning and mentoring.
- Opinion about the support provided by the programme in projects, modern tools and softwares.
- Support provided for extra-curricular and co-curricular activities.
- Exposure to the competitive exams and personality development programmes.
- Insight on imparting skills like entrepreneurship and societal responsibility through NSS, YRC, NGO and Club's
- Improvement on facilities.

PO & PSO Attainment Calculation of PES:

Question Level Calculation:

$O(x)$ in %

$$= \frac{no.\,of\,Students\,provided\,more\,than\,or\,equal\,to\,3\,Marks\,in\,(x)}{no.\,of\,Students} \times 100$$

Where, x= [1 to 25], Q[x]=x^th^ Questions in Program Exit Survey

Question Level Attainment:

Program Exit Survey (PES) Question Level Attainment	3	80% of the Students provided more than or equal to 3 Marks in Survey Question
	2	70% of the Students provided more than or equal to 3 Marks in Survey Question
	1	60% of the Students provided more than or equal to 3 Marks in Survey Question

Table 5 PES Attainment level

$$POm\,Attainment\,of\,PES = \frac{\sum_{i=1}^{x}(x)inment\,mapped\,with\,POm}{x}$$

Where, m= [1 to M], M= Number of Program Outcomes.
x=Number of Questions mapped with POm

$$PSOm\,Attainment\,of\,PES = \frac{\sum_{i=1}^{x}(x)ainment\,mapped\,with\,PSOm}{x}$$

Where, m= [1 to M], M= Number of Program Specific Outcomes.
x=Number of POs mapped with PSOm

Alumni Survey:

The alumni survey is conducted through the survey questionnaire after graduation towards the achievement of POs and PSOs. Survey form is structured with six sections with respect to,

- Personal information.
- Employment/higher studies/entrepreneurship- details.

- Technical, professional, communication and general skills at present towards RIT contribution.
- Experience at RIT in projects, extra-curricular, co-curricular activities, personality development, sports, NSS and YRC facilities.
- Suggestions for further improvement.
- Suggestions for bridging curriculum gap and other valuable inputs.

PO & PSO Attainment Calculation of AS:

Question Level Calculation:

$$O(x) \text{ in } \% = \frac{no. \ of \ Students \ provided \ more \ than \ or \ equal \ to \ 3 \ Marks \ in \ (x)}{no. \ of \ Students} \times 100$$

Where, x= [1 to 25], Q[x]=x^{th} Questions in Alumni Survey

Question Level Attainment:

Alumni Survey (AS) Question Level Attainment	3	80% of the Students provided more than or equal to 3 Marks in Survey Question
	2	70% of the Students provided more than or equal to 3 Marks in Survey Question
	1	60% of the Students provided more than or equal to 3 Marks in Survey Question

Table 6 Alumni Survey Attainment level

$$POm \ Attainment \ of \ = \frac{\sum_{i=1}^{x} (x) inment \ mapped \ with \ POm}{x}$$

Where, m= [1 to M], M= Number of Program Outcomes.
x=Number of Questions mapped with POm

$$PSOm \ Attainment \ of \ = \frac{\sum_{i=1}^{x} (x) ainment \ mapped \ with \ PSOm}{x}$$

Program level PO& PSO Indirect Attainment Calculation:

$$POm\ Indirect\ Attainment = (POm\ Attainment\ of\\ PES\ X\ 0.5) + (POm\ Attainment\ of\ AS\ X0.5)$$

Where m= number of Program Outcomes

$$PSOm\ Indirect\ Attainment = (PSOm\ Attainment\ of\ PES\ X0.5) + (PSOm\\ Attainment\ of\ AS\ X\ 0.5)$$

Where m= number of Program SpecificOutcomes

Overall PO & PSO Attainment Calculation:

The Overall PO & PSO attainment is calculated by using the following formula

$$Overall\ POm\ Attainment\\ = (POm\ Direct\ Attainment\ X\ 0.8)\\ + (POm\ Indirect\ Attainment\ X\ 0.2)$$

Where m= number of ProgramOutcomes

$$Overall\ PSOm\ Attainment\\ = (PSOm\ Direct\ Attainment\ X\ 0.8)\\ + (PSOm\ Indirect\ Attainment\ X\ 0.2)$$ *Where m= number of Program SpecificOutcomes*

The following table 3.3.1.5. shows the tools and process for Indirect PO attainment.

PO Attainment	Tools	Process
Indirect	• Program Exit Survey	On completion of program, a feedback is obtained from each student about the entire program experience.
	• Alumni Survey	During the alumni meet, graduation day the alumni survey are collected from the graduates based on the various parameters.

Table 7 Indirect Assessment Process