

A SIMPLE APPROACH TO CALCULATE CO & PO ATTAINMENT LEVELS BY DIRECT AND INDIRECT METHODS

Ch. Santhi Rani¹, Dr. K. Raja Sekhara Rao², K. Eliah³

¹Dean Academics ²Director ³Associate Professor

Usha Rama College of Engineering & Technology, Telaprolu, India

Abstract : An Outcome Based Education (OBE) is student centric instruction model that focuses on measuring the performance of student through outcomes. OBE model is adopted at faster rate in Indian Engineering Colleges to help Indian engineers to compete with their counterparts in other parts of the globe. The primary focus of this paper is to calculate the attainment levels of Course Outcomes (COs) and Program Outcomes (POs) for engineering courses and programs as mentioned in NBA Self Assessment Report, June 2015 for tier II institutions.

IndexTerms - Course Outcomes (COs), Program Outcomes (POs), Outcome Based Education (OBE).

I. INTRODUCTION:

Students who are studying in NBA accredited institutions will receive high quality education with professional relevance. The NBA, India was established in 1994 by AICTE with effect from 7th Jan 2010. NBA has become an autonomous government body that is responsible for accreditation of various technical and professional programs of institutions across the country. To recognize and promote excellence in technical education in universities and colleges NBA accreditation is required.

In the year 2014, on June 13th, NBA has become permanent signatory member of the Washington Accord. The NBA accredited programmes offered by Tier –I and Tier – II institutions are eligible for the recognition of the programmes by other signatories of the Washington Accord. Institutions of National importance like IITs, IISc, IITDM, IISER, IIITs, NITs, Central Universities, State Universities, Private Universities, Deemed to be universities and autonomous institutions in India are eligible to get recognition under Tier –I institutions by NBA. Whereas colleges affiliated to universities not enjoying the privileges of full academic autonomy are eligible under Tier – II institutions by NBA. Outcome based accreditation focuses on evaluation of outcomes of the programme that is understanding fundamentals very well and learning new skills and competencies.

Important Terms Used in Accreditation Document of NBA in its Self Assessment Report

- 1. Outcome Based Education (OBE):** Outcome Based Education emphasizes on stating what students are to be able to do at the end of the program.
- 2. Vision, Mission Statements:** Statements are written in a simple language, easy to communicate and should define objectives which present near future of the institute. Vision and Mission statements are formulated by involving all stakeholders and conducting brain storming discussions. Vision is something to be pursued and Mission is something to be accomplished.
- 3. Programme Outcome (PO):** POs are statements about the knowledge, skills and attitudes. The graduate of a formal engineering program should have all. Pos deal with competencies and expertise a graduate, who will possess even after completion of the programme. POs reflect 12 graduate attributes provided by the NBA.

PO1: Engineering Knowledge

PO2: Problem Analysis

PO3: Design / Development of Solutions

PO4: Conduct investigations of complex problems

PO5: Modern tool usage

PO6: The engineer and the society

PO7: Environment and Sustainability

PO8: Ethics

PO9: Individual and Teamwork

PO10: Communication

PO11: Project management and finance

PO12: Life Long Learning

Program Educational Objectives (PEOs): PEOs are statements that describe the career and professional accomplishments that the programme is preparing the graduates to achieve. PEOs are measured 4 – 5 years after graduation.

Course Outcomes (CO): COs are statements which are course specific. They cover the core course related outcomes and contribute to the overall attainment of the programme outcomes. Each course is designed to meet about 5 to 6 Course Outcomes.

Evaluation: Evaluation determines the extent to which POs are being achieved.

Mapping: Mapping is the process of representing the correlation among the parameters in one to many, many to one and many to many parameters.

Bloom’s Taxonomy of Learning: In 1956, Benjamin Bloom with collaborators Max Englehart, Edward Furst, Walter Hill and David Krathwohl published a frame work for categorizing educational goals. In Blooms Taxonomy, six types of thinking are arranged from simple to complex as shown in Fig.1.. Blooms Taxonomy helps the teacher to plan and deliver appropriate instruction and ensures that the instruction and assessment are aligned with the objectives.

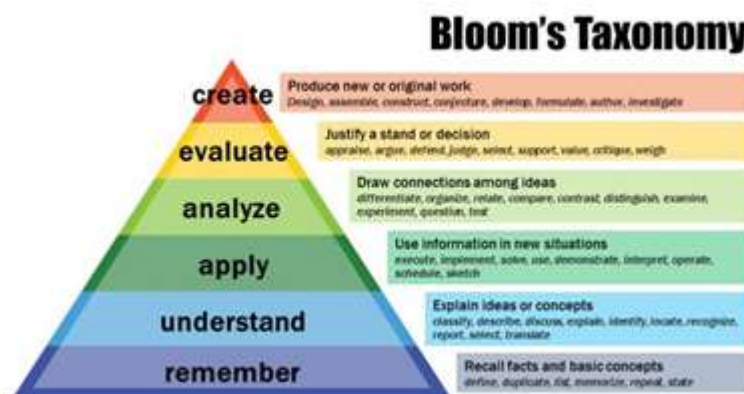


Fig.1: Bloom’s Taxonomy

Most of the engineering colleges in Andhra Pradesh are affiliated to Jawaharlal Nehru Technology University, Kakinada, AP. The university provides syllabus for various engineering courses, where all courses have their own objectives and methodologies to achieve the course outcomes. Some courses are theoretical in nature, some are practical and some are theoretical with practical sessions. To calculate attainment of course outcomes of the course, the faculty members use various indirect and direct assessment methods. Calculation of CO and PO attainment involves lot of clerical work.

Course Outcome Assessment Methodology: The process of calculating attainment of Cos and POs starts from writing appropriate COs per each course in the four year engineering degree program. The course outcomes are written by respective faculty member using action verbs of learning levels as suggested by Bloom’s Taxonomy. Then a correlation is established between COs and POs on the scale of 1 to 2, 1 being the low correlation, 2 being high correlation.

A 4x12 mapping matrix of COs – POs is prepared in this regard for all courses in the program. Course outcomes and the CO – PO mapping matrix for a sample course is discussed below.

Course Outcomes of the Course: RT 41041 VLSI Design. After the completion of the VLSI design course, the student will be able to

CO1: Understand IC Fabrication process steps required for MOS circuits

CO2: Analyze electrical properties for circuit level and gate level models

CO3: Design VLSI circuits.

CO4: Learn concepts of ASICs, FPGAs and EDA tools.

CO – PO mapping matrices are to be prepared for all the theory and practical courses.

CO-PO mapping matrix for the course VLSI design is shown in Table.1

Table 1: CO – PO mapping matrix for RT41041 VLSI Design

Course Outcomes (COs)	Program Outcomes (POs)												
	a	b	c	d	e	f	g	h	i	j	k	l	
CO 1	2		2				1		1	2			2
CO 2	2		2	2	2	1						1	2
CO 3	2		2		2			2	1			1	2
CO 4	2	2		2	1			2	1			1	2

2: High correlation

1: Low Correlation

In Usha Rama College of Engineering and Technology, which is a JNTUK affiliated college, the CO assessment tools used to measure the attainment levels are: Mid Term Exam – I, Mid Term Exam – II, Assignment – I, Assignment – II, Semester End Exams and performance during experiments etc. All these are direct assessment tools. Course exit survey is also conducted at the end of the semester. Different weights are assigned to each of the above tools.

In Usha Rama College of Engineering and Technology, two midterm examinations are conducted for each course in a semester. Mid term exams are for 15 marks each. Similarly each student is given two assignments based on COs and marks awarded for each assignment to the student are 5.

Table 2: Co Assessment for the course of VLSI

USHA RAMA COLLEGE OF ENGINEERING AND TECHNOLOGY: TELAPROLU													
ANSWER SHEET EVALUATION ANALYSIS													
Programme: B.Tech ECE										MID / ASSIGNMENT: II MID			
Year / Sem: IV B.Tech , I Semester										Max. Marks: 15			
Course Code & Name: RT41041, VLSI													
Course Instructor: Dr. CH. Santhi Rani													
Sl. No	Regd.No	Name of the Student	Q.No 1a	Q.No 1b	Q.No 2a	Q.No 2b	Q.No 3a	Q.No 3b	CO1 Max Marks :5	CO2 Max Marks :5	CO3 Max Marks : 3	CO4 Max Marks : 2	Total Marks (15)
			CO1	CO1	CO2	CO2	CO3	CO4					
1	14NG1A0443	DURGA BHAVANI GUDIKANDULA	3	2	3	2	3	2	5	5	3	2	15
2	14NG1A0492	RUTH SUHASINI CHABATHULA	2	2	3	2	3	2	4	5	3	2	14
3	14NG1A04B3	SAI PRAVEEN YAKKALA	2	2	2	2	2	2	4	4	2	2	12
4	15NG1A0402	ANGADLALA SASI KUMAR	1	2	3	1	3	1	3	4	3	1	11
5	15NG1A0403	AVULA VENKATA MANI CHANDRA REDDY	3	2	3	2	3	1	5	5	3	1	14
6	15NG1A0404	AVUTHU DIVYA	0	0	3	2	3	2	0	5	3	2	10
71	15NG1A04D6	KOTI REDDY SANGATI	2	2	3	2	2	2	4	5	2	2	13
72	15NG1A04D7	BALA BHAVYA SRI THOTA	2	0	3	1	3	2	2	4	3	2	11
BLOOM'S TAXONOMY			Remembering [R]		Analysis [A]				Max Marks CO wise				
			Understanding [U]		Evaluation [E]								
			Applying [P]		Create [C]				CO1	CO2	CO3	CO4	
Question Wise Max Marks			2	3	3	2	2	3	5	5	3	2	
Level / Competence 60% threshold			A	U	P	R	E	C	3	3	2	1	
Co wise No of students above threshold 60%			CO1	CO1	CO2	CO2	CO3	CO4	45	61	59	44	

Table.3 Quality of the Question Paper based on Bloom's Taxonomy

Quality of Question Paper based on Bloom's Taxonomy	
Bloom's Taxonomy	
Remembering [R]	2
Understanding [U]	3
Applying [P]	3
Analysis [A]	2
Evaluate [E]	2
Create [C]	3

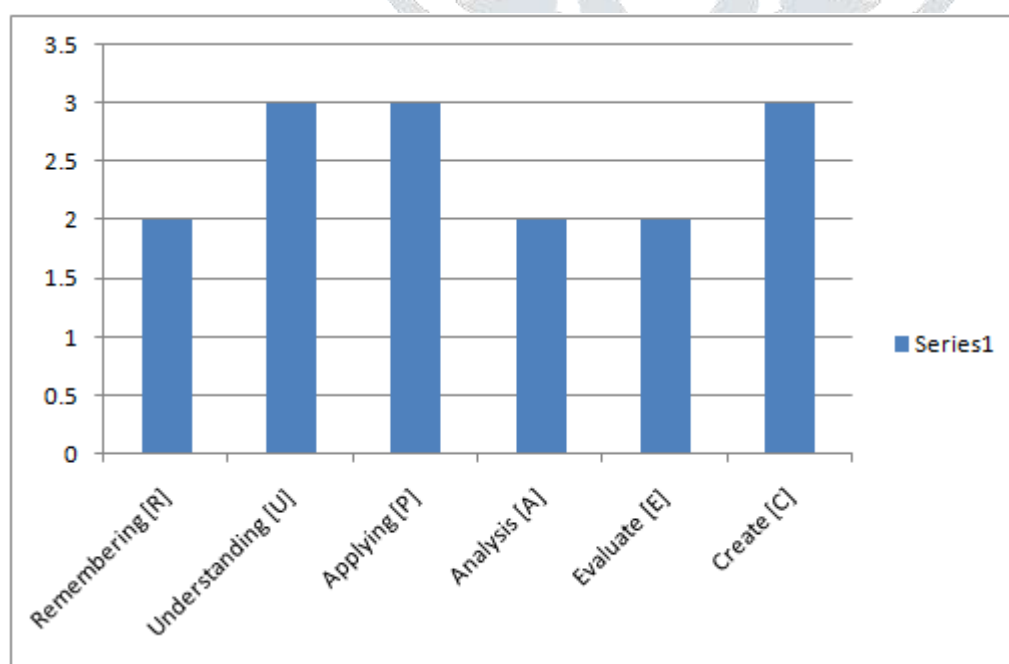


Fig. 2 Blooms Taxonomy level of the Question Paper under consideration

Table.4: Bench Mark and Attainment

BENCH MARK AND ATTAINMENT			
			Attainment
LEVEL	60% students got more than target	$\frac{72 \text{stud} * 60}{100}$	43.2
	70% students got more than target	$\frac{72 \text{stu} * 70}{100}$	50.4
	80% students got more than target	$\frac{72 \text{stud} * 80}{100}$	57.6

According to SAR of NBA, the attainment level threshold values are defined as follows.

- (i) 60% of students who score more than 60% marks out of the maximum relevant marks is set as attainment level1.
- (ii) 70% of students who score more than 60% marks out of the maximum relevant marks is set as attainment level2.
- (iii) 80% of students who score more than 60% marks out of the maximum relevant marks is set as attainment level3.

For the VLSI design course in this example considered, the target attainment level for each CO and for each student is set at 60% of the maximum marks for a question or group of questions.

Table.5: Students above threshold value for course of VLSI design in Mid II

STUDENTS ABOVE THRESHOLD			
			ATTAINMENT
MID 2	CO1	45	1
	CO2	61	3
	CO3	59	3
	CO4	44	1

Table.6 Indirect Assessment for the course of VLSI

USHA RAMA COLLEGE OF ENGINEERING AND TECHNOLOGY: TELAPROLU						
INDIRECT ASSESSEMENT - RESPONSE OF FEED BACK FROM STUDENTS						
Programme: B.Tech ECE						Strongly Agree: 3
Year / Sem: IV B.Tech , I Semester						Agree: 2
Course Code & Name: RT41041, VLSI						Neutral: 1
Course Instructor: Dr. CH. Santhi Rani						Disagree: 0
Sl. No	Regd.No	Name of the Student	CO1	CO2	CO3	CO4
1	14NG1A0443	DURGA BHAVANI GUDIKANDULA	3	2	3	3
2	14NG1A0492	RUTH SUHASINI CHABATHULA	3	3	3	3
3	14NG1A04B3	SAI PRAVEEN YAKKALA	3	2	0	2
4	15NG1A0402	ANGADLALA SASI KUMAR	3	2	3	3
5	15NG1A0403	AVULA VENKATA MANI CHANDRA REDDY	3	2	0	3
71	15NG1A04D6	KOTI REDDY SANGATI	3	3	3	3
72	15NG1A04D7	BALA BHAVYA SRI THOTA	3	3	3	3
Average			2.88	2.89	2.57	2.75
Final Indirect attainment			2.77			

Table.7 Course Attainment for the course of VLSI

COURSE ATTAINMENT									
FINAL DIRECT COURSE ATTAINMENT CALCULATION							FINAL INDIRECT COURSE ATTAINMENT CALCULATION		
	MID1	MID2	ASGN1	ASGN2	INTERNAL	UNIV			
CO1	1	1	1	1	1	3	CO1	2.88	
CO2	2	3	2	1	2	3	CO2	2.89	
CO3	1	3	2	1	1.75	3	CO3	2.57	
CO4	3	1	2	2	2	3	CO4	2.75	
Attainment					1.6875	3	Final Indirect Course Attainment	2.77	
Weightage					30%	70%			
Direct total Attainment					0.50625	2.1			
Final Direct Course Attainment					2.60625				
Weightage					80%		20%		
Total Attainment					2.085		0.55		
Course Attainment					2.6				

Table.8 CO vs PO Mapping and Course PO Attainment

CO vs (PO, PSO) MAPPING AND COURSE PO ATTAINMENT														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2	2					1	2		2	1	2
CO2	2		2	2	2	1	1				1	2	1	2
CO3	2		2	2	2			2	1		1	2	1	2
CO4	2	2		2	1			2	1		1	2	1	2
Average	2	2	2	2	1.67	1	1	2	1.5	1	1	2	1	2
Course PO Attainment	1.76	1.76	1.76	1.76	1.5	0.88	0.87	1.76	1.3	0.87	0.87	1.76	0.87	1.73

Overall Course attainment: The example guide lines in NBA SAR suggests to use a proportion of 80% weightage to semester end exams and 20% weightage to internal exams for computing overall attainment for a course as shown in Table 7.

The procedure of computing overall CO attainment is to be repeated for each course from I year to IV year in an academic year (including Elective courses, Open Electives, Technical seminars and project work) in order to enable computation of PO and PEO attainment levels.

Attainment of POs: Program outcomes are step broader statements than COs that describe what students are expected to know and be able to do upon their graduation. June 2015 formats of SAR includes POs defined common to programs. However NBA suggests programs to define 2 to 4 POs specific to an engineering program and are called program Specific Outcomes (PSOs). It is required to compute the attainment of levels for PSOs in addition to computing attainment of POs. Through COs, POs and PSOs are attained. This method of calculating PO and PSO attainment is called direct attainment. The over all Co attainment value of 2.6 is obtained from Table.7

The individual PO attainment values are averaged to calculate direct attainment of PO. For determining indirect attainment of POs and PSOs SAR suggests student exit surveys, employer surveys, co curricular activities and extracurricular activities etc.

An action plan for Pos and PSOs that do not reach the target attainment value must be designed and implemented in the subsequent academic year.

Conclusion: The paper has proposed a simplified methodology for computing the attainment values of COs, POs and PSO. The obtained COs are compared with the target attainment values. The action plans may be laid for those COs, POs and PSOs whose attainment value is less than the target value. This methodology can be used for the measurement of COs, POs and PSOs in an autonomous institutions. This paper helps faculty members in calculating the attainment levels of course outcome and program outcome. The attainment levels in turn help to monitor the students performance as well as teaching efficiency.

References

- [1]. National Board of Accreditation Self-Assessment Report (SAR) For Engineering Programs of Tier – II Institutions – First Time Accreditation, June 2015, available at <http://www.nbaind.org/En/1079-self-assessment-report-tier-ii.aspx>
- [2]. Evaluation guidelines by NBA, available at <http://www.nbaind.org/files/evaluation-guidelines-tier-ii-v0.pdf>
- [3]. Bloom, B. S, “Taxonomy of Educational Objectives, Hand Book 1: The Cognitive Domain”, New York: David McKay Co Inc.
- [4]. Anderson, L. W., and Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.
- [5]. Accreditation Manual for UG Engineering Programmes (Teir-II), available at <http://www.nbaind.org>
- [6] Bhimasen Soragaon1, K S Mahesh, “Measuring Attainment of Course Outcomes and Program Outcomes – A Simplified Approach as per Self-Assessment Report - June 2015” IOSR Journal of Research & Method in Education (IOSR-JRME, Volume 6, Issue 4 Ver. IV (Jul. - Aug. 2016), PP 13-18