

Ingenious Methodology for Assessment of Program Outcomes (POs) in TIER-II SAR (June 2015) of NBA

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ABSTRACT

The Outcome Based Education (OBE) has been one of the major concerns of Engineering and Technology (EAT) institutions in India. This paper aims to provide an evaluation method for the attainment of Program Objectives for engineering graduates as defined in SAR (Self Assessment Report, June 2015) format, by NBA (National Board of Accreditation) for Tier II EAT institutions. As NBA requires specific evaluation techniques and measurement methods for measuring the attainment of Program Outcomes (PO) and Program Specific Outcomes (PSO), this paper provides definite methodology for assessment of PO. Execution of the OBE may not be an easy stuff as the mapping of the Course Outcome (CO) for each assessment may be mapped to multiple PO. This paper describes the analysis process of the CO and PO attainment for the Mechanical Engineering program, University of Mumbai. However the methodology is applicable for all programs offered by Tier II EAT institutions. The decisive aim of this paper is to provide guidelines for CO-PO mapping, Course-PO mapping required for PO attainment calculation.

Keywords: Program Outcome, Course Outcome, NBA, OBE.

INTRODUCTION

Accreditation is a process of quality assurance and improvement, whereby a program in an approved Institution is critically appraised to verify that the program continues to meet and/or exceed the Norms and Standards prescribed by regulator from time to time. The implementation of Outcome Based Education (OBE) has been among the main focus of EAT institution in India, especially among engineering departments when India has become the permanent signatory member of the Washington Accord on 13th June 2014, through the National Board of Accreditation [1].

The revised SAR for Tier II EAT Institutions in India is introduced in June 2015 by NBA. Ten criteria's, which are considered by NBA during the process of accreditation of a program, are determined by the NBA's definition of quality of programs and its relevance to the profession concerned. The second criterion which is "Program Outcome" is most critical to attain by institutions.

The parameters in second criteria of NBA, to be classified include the student attainment of CO, PO and PSO, etc.

Program Specific Outcomes [PSO]

The Program Specific Outcomes reflect the qualities that the student acquired in about 5 years after completing the course.

Program Outcomes [PO]

Program Outcomes define the qualities attained by the students on completing the program. The program objectives defined by NBA are shown below.

- Engineering Knowledge-[PO1]
- Problem Analysis- [PO2]
- Design/development of solutions-[PO3]
- Conduct investigation of complex problems-[PO4]
- Modern Tool Usage-[PO5]
- The Engineer and Society-[PO6]
- Environment and Sustainability-[PO7]
- Ethics- [PO8]
- Individual and Team work- [PO9]
- Communication – [PO10]
- Project Management and Finance- [PO11]
- Life-long Learning –[PO-12]

Course Outcomes [CO]

Course Outcomes define the qualities attained by the students on completing the particular course on a subject. The extent of attainment of course outcomes is measured by rubrics.

Rubric can be used as the measurement tools for the attainment of the program outcomes. The method of framing rubrics for the twelve PO's of the NBA is as shown below. The four logical levels of measurement are defined. Rubrics are written for all the twelve PO's to suit the requirements of the respective departments. The instruments like tests, assignments etc. are assessed by concerned faculties based on the grading scheme given in the Rubric Table 1.

Table 1: Rubric and Associated Grading Scheme

<i>Measurement</i>	<i>Needs Improvement</i>	<i>Can Do Better</i>	<i>Satisfactory</i>	<i>Exceeds Expectation</i>
Marks	> 40%	41 to 60%	61 to 80%	81 to 100%
Test Que. Marks (e.g.) 10	<=4	4<=6	6<=8	8 <=10
Assignment Que. Marks (e.g.) 15	<= 6	6 <=9	9 <= 12	12 <=15
University Que. Marks (e.g.) 5	<= 2	2 <=3	3 <= 4	4 <=5

CO ATTAINMENT (COA) CALCULATION

The assessment tools can be any method to find out if the student has attained the objective of the course being taught as a part of curriculum. Some of the methods for assessing the students

laid down by NBA are midterm tests, assignments, mini projects, reports and presentations are used for assessing the CO attainment. The attainment levels and the associated criteria, as decided by the Mechanical Engineering Program is shown in the Table 2.

Table 2: Attainment Levels and Associated Criteria for COA

<i>Criteria (CR)</i>	<i>CR1</i>	<i>CR2</i>	<i>CR3</i>	<i>CR4</i>
% of Students	> 60%	61 to 70%	71 to 80%	81 to 100%
Attainment Level	0	1	2	3

Model 1 for COA (As suggested in SAR)

Assuming 80% weightage to University examination and 20% weightage to Internal assessment, the attainment calculations will be (80% of University level) + (20% of Internal level) i.e. 80% of 0 + 20% of 1 = 0 + 0.2 = 0.2 as shown in Table 3.

Table 3: COA calculation as suggested in SAR

<i>DESCRIPTION of MEC202.1 Attainment</i>				
Course Code	<i>MEC202</i>			
Course Name	<i>Strength of Material</i>			
Course Outcome	<i>MEC202.1</i>			
	<i>Internal Assessment</i>			<i>University</i>
Assessment Instruments for MEC202.1	<i>Test I</i>	<i>Assignment I</i>	<i>Test II</i>	<i>Exam</i>
Maximum Mapped Marks In Each Instrument	5	5	10	15
Student a	3	5	9	10
Student b	4	5	2	15
Student c	0	5	6	5
Student d	5	4	5	4
% of Students with marks >80%	25%	75%	25%	25%
% of Students with marks 71 to 80%	25%	25%	0%	0%
% of Students with marks 61 to 70%	0%	0%	0%	25%
% of Students with marks Below 60%	25%	0%	75%	50%
Assignment of levels for Criteria 1	0	2	0	0
Assignment of levels for Criteria 2	0	0	0	0
Assignment of levels for Criteria 3	0	0	0	0
Assignment of levels for Criteria 4	0	0	2	0
Attainment Levels in respective Head	0	1.5	1.5	0
MEC202.1 Attainment by Internal Assessment	1			
MEC202.1 Attainment by University Exam	0			
MEC202.1 Final Attainment (3 point scale)	0.2			

Model 2 for COA (Reformed Method of Attainment)

The model 2 shows calculation of course outcome attainment by modified method. The model considers the combined assessment by direct and indirect method. The indirect method includes the course exit survey form filled by students based on 3 point scale. Assuming 80% weightage to Direct Assessment and 20% weightage to Indirect assessment, the COA calculations will be (80% of Direct) + (20% of Indirect) i.e. 80% of 0.75 + 20% of 1.5 = 0.6 + 0.3 = 0.9 as indicated in Table 4.

Table 4: COA Calculation by Reformed Method

<i>DESCRIPTION of MEC202.1 Attainment</i>	<i>Direct Assessment</i>				<i>In-Direct Assessment</i>
	<i>Internal Assessment</i>			<i>Univ.</i>	<i>Exit Survey</i>
<i>Assessment Instruments for MEC202.1</i>	<i>Test I</i>	<i>Assignment</i>	<i>Test II</i>	<i>Exam</i>	<i>Course</i>
Course Code	MEC202				
Course Name	Strength of Material				
Course Outcome	MEC202.1				
Maximum Mapped Marks In Each	5	5	10	15	3
Student a	3	5	9	10	3
Student b	4	5	2	15	3
Student c	0	5	6	5	3
Student d	5	4	5	4	2
% of Students with marks >80%	25%	75%	25%	25%	75%
% of Students with marks 71 to 80%	25%	25%	0%	0%	0%
% of Students with marks 61 to 70%	0%	0%	0%	25%	25%
% of Students with marks Below 60%	25%	0%	75%	50%	0%
Assignment of levels for Criteria 1	0	2	0	0	2
Assignment of levels for Criteria 2	0	0	0	0	0
Assignment of levels for Criteria 3	0	0	0	0	0
Assignment of levels for Criteria 4	0	0	2	0	0
Attainment Levels in respective Instrument	0	1.5	1.5	0	1.5
MEC202.1 Attainment by Direct	0.75				
MEC202.1 Attainment by In-Direct	1.5				
MEC202.1 Final Attainment (3 point	0.9 (Improved as compared to Model 1)				

PO ATTAINMENT CALCULATION

The parameters adopted by NBA for accreditation of program are based on initial capabilities, competence, skills, etc. keeping in mind the outcomes desired by the profession concerned. These

parameters are called Program Outcomes and for Tier-II EAT institutions Twelve PO's are listed in SAR as Annexure I [2].

Table 5 represents the mapping of CO's and PO's according to three correlation levels viz. 1-low, 2-Moderate and 3-Substantial. If the particular PO is not attained through relevant CO, then the level is not entered. The critical value for POA set by Mechanical Engineering Program is 50% marks in the mapped questions. The criteria to assign the correlation level are same as used for COA in Table 2.

Table 5: POA Calculation for Course MEC202

<i>PO</i>	<i>PO1</i>		<i>PO2</i>	<i>PO3</i>	<i>PO4-PO6</i>	<i>PO7</i>	<i>PO8</i>	<i>PO9</i>	<i>PO10</i>	<i>PO11</i>	<i>PO12</i>
CO	MEC	MEC	MEC	MEC		MEC	MEC		MEC		MEC
	202.1	202.2	202.3	202.4		202.1	202.2		202.5		202.6
	Test II	Univ.	Ass.	Test I		Univ.	Test II		Univ.		Test I
Q.Marks	10	15	5	8	–	10	15	–	5	–	8
Student a	5	12	4	7	–	5	12	–	4	–	7
Student b	8	11	3	2	–	8	11	–	3	–	2
Student c	7	8	4	7	–	7	8	–	4	–	7
Student d	3	10	1	6	–	3	10	–	1	–	6
Critical value	% of students obtaining more than or equal to 50% marks										
Criteria	75%	100%	75%	75%		75%	100%		75%		75%
Level	3	3	2	2		2	3		2		2

The values obtained from Table 5 are entered in Table 6 to obtain CO-PO mapping matrix for course MEC202.

Table 6: CO-PO Mapping Matrix for Course MEC202

<i>CO/PO</i>	<i>PO1</i>	<i>PO2</i>	<i>PO3</i>	<i>PO4</i>	<i>PO5</i>	<i>PO6</i>	<i>PO7</i>	<i>PO8</i>	<i>PO9</i>	<i>PO10</i>	<i>PO11</i>	<i>PO12</i>
MEC202.1	3						2					
MEC202.2	3							3				
MEC202.3		2										
MEC202.4			2									
MEC202.5										2		
MEC202.6												2
MEC202	3	2	2				2	3		2		2

Program level Course and PO mapping matrix is prepared by collecting the values from CO- PO mapping matrices for all courses as shown in Table 7. The values for other courses are assumed.

Table 7: Program Level Course-PO Mapping Matrix

Course/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MEC101	1	1	2			1			2			
MEC202	3	2	2				2	3		2		2
MEC303	3	2		2	1	2	1			1	2	2
MEC404	1	1	1	3	2	1	2	2	1	2	1	

Final POA calculation is done by combining the direct and indirect attainment as shown in Table 8. Indirect attainment is obtained from employer survey or graduate program exit survey.

PO1 by direct attainment is $(1+3+3+1)/4=2$ and by indirect attainment is 1.

Final PO1 Attainment level will be 80% of direct assessment + 20% of indirect assessment i.e. $1.6 + 0.2 = 1.8$

Similarly the attainment levels of other PO's may be calculated.

Table 8: Final POA Calculation

Course/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MEC101	1	1	2			1			2			
MEC202	3	2	2				2	3		2		2
MEC303	3	2		2	1	2	1			1	2	2
MEC404	1	1	1	3	2	1	2	2	1	2	1	
Direct Attainment	2	1.5	1.67	2.5	1.5	1.33	2.5	2.5	1.5	1.66	1.5	2
Indirect Attainment	1	2	2	1		2	1		3	1	2	3
PO Attainment	1.8	1.6	1.73	2.2	1.2	1.46	2.2	2	1.8	1.53	1.6	2.2

RESULTS & DISCUSSION

The first part of the article portrays the measurement of COA, which describes the two models of calculation. The second part shows the calculation of POA. The last part sheds light on the target and actual values of POA, and describes the method for setting the next target levels. If the target is achieved then the next target level must be forecasted according to the quality of students, academic performance of students in first/second/third year, success rate in stipulated period etc.

Subject coordinator holds a big responsibility of designing the subject curricular that can ease the attainment analysis process. All assessments to be implemented in the course (e.g. Assignment,

Test, Project, and Final Exam) should be prepared before the beginning of the semester. This is achievable if the subject coordinator has been involved in the same subject for at least one teaching semester since they would have adequate insight on preparing the teaching plan and the CO as per the predetermined PO and PSO.

The EAT institutions in India may ripen a system that provides standardized CO-PO attainment analysis. The system should consider the constraints among academic members who are directly involved with data collection and data management activity. The system interface should be easily steered as it plays a significant role towards encouraging the commitment of academic members.

CONCLUSION

This article explicates the process of measuring Program Outcomes according to SAR format for TIER-II EAT institutes in India, in detail. As the new format of SAR for TIER -II is prescribed from June 2015, the method presented in this article shall be useful for EAT institutes in India.

Finally, the efficiency of OBE implementation drives back to the exercise of the related academic members. They have to be proactive in managing the data on time so that the activity would not be too overwhelming at the end of the semester. Proper planning will definitely lead to fruitful result with less hassle in managing the extra requirement by NBA.

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