Abstract:
Education is a form of learning in which the knowledge, skills and information are transferred from teachers to students. The transition from output based education to outcome based education is the real need and demand of the 21st century learning system. Outcome Based Education (OBE) system has the ability to measure what the students are capable of. This paper proposes OBE system of NBA (National Board of Accreditation) Tier II accreditation in engineering colleges. NBA has released the modified version of Self Assessment Report (SAR) in their website and has included ten different criteria to provide OBE with different prospective. This paper presents assessment methods and attainment of course outcome and program outcome. Sample calculations are also included in this paper for the measurement of CO and PO.

Keywords: CO, PO, CO-PO mapping, CO-PO assessment and attainment, NBA Tier II accreditation.

I. Introduction
OBE is an educational theory that involves and includes every stage and part of the educational system around goals or outcomes. An outcome of an education is what the student would be able to do after the completion of a program or a course. There are four levels of outcome such as course outcome (CO), program outcome (PO), program specific outcome (PSO), and program educational objective (PEO). COs are statements that declare what students should be able to do at the end of a course. POs are statements that explain what the students graduating from engineering program should be able to do. PSOs are statements that assert what the graduates of a specific engineering program should be able to do. PEOs are broad statements that tabulate and describe the future career and professional accomplishments of all the individuals concerned who undergo the program during significant years of study of graduation.

II. Mapping of CO with PO
The course in-charge of the subject has to write appropriate COs for their corresponding course (subject). COs are narrower statements and are measurable. It will be written using the action verbs of learning levels. These are related to the skills, knowledge and behavior that students will acquire through the course. CO will map with PO of the department. The subject expert will be nominated as course coordinator of the corresponding course and he/she has to review the CO statements and CO-PO mapping.

The year wise coordinator has to maintain the documentation of the CO attainment level of the respective year courses as well as documentation of the individual student’s extra and co-curricular activities in order to evaluate PO. The program coordinator has to evaluate the PO attainment of every individual student through direct and indirect method, once the student completes their program. All these work are to be carried under the guidance of Department Advisory Board. A sample course outcome statements and sample CO-PO matrix are given in Table 1 and Figure 2 respectively.

Table 1: Sample CO statements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CO</th>
<th>Course Outcome Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>C204.1</td>
<td></td>
<td>Able to identify various network devices to build a network.</td>
</tr>
<tr>
<td>C204.2</td>
<td></td>
<td>Analyze functions of data link layer.</td>
</tr>
<tr>
<td>C204.3</td>
<td></td>
<td>Analyze various routing algorithms in networking.</td>
</tr>
<tr>
<td>C204.4</td>
<td></td>
<td>Analyze various protocols for reliable transmission.</td>
</tr>
<tr>
<td>C204.5</td>
<td></td>
<td>Be exposed to the required functionality at application layer.</td>
</tr>
</tbody>
</table>

The CO-PO mapping has been done with correlation levels of 3, 2, 1 and ‘-’. The notation of 3, 2 and 1 stands for substantially (high), moderately (medium) and slightly (low). The meaning of ‘-’ is no correlation between CO and PO.

Figure 2: Sample CO-PO Matrix

Average value has to be taken for each CO. Average CO value is calculated by Sum of Rubrics in each column is divided by
The number of CO mapped in each column (need not to consider ‘-’ entered).

Example: C204-PO1 = (2+3/2) = 2.5

The course in-charge has to identify the curricular gap if any, based on the recent technological trends as well as on the feedback assessed and consequently proper steps are to be identified to bridge the curricular gap. PO will map with PSO and PEO. The pictorial representation of CO-PO and PSO-PEO mapping is given in the figure 3.

Figure 3: Relationship between CO, PO & PSO and PEO

Program level CO-PO matrix for all the courses including first year courses will be done by the program co-ordinator and a sample is given in figure 4.

Assessment methods employed in this paper are direct assessment method for 80% and indirect assessment method for 20%. The direct assessment process of CO attainment is evaluated through internal tests and end semester examination. The rubrics considered in this paper are given below:

**Attainment Level 1**: 50% of students score more than 50% marks out of the maximum relevant marks. **Attainment Level 2**: 60% of students score more than 50% marks out of the maximum relevant marks. **Attainment Level 3**: 70% of students score more than 60% marks out of the maximum relevant marks. As per NBA guidelines, program can appropriately define the attainment level. Example calculation indicated in this paper is only a reference. Course exit survey from the student may be considered for the indirect assessment of CO. Sample calculations of CO assessment through direct and indirect methods are given in Figures 5, 6, 7, and 8.

Figure 4: Program level CO-PO matrix

Figure 5: Calculation for Internal Assessment 1

Figure 6: Calculation for Internal Assessment 2

Figure 7: Calculation for Internal Assessment 3

Figure 8: Calculation of CO through Direct and Indirect attainment

Figure 9: CO attainment through direct and indirect methods

Similarly CO can be measured for all the courses. PO attainment is obtained through direct and indirect methods and is shown in figure 11 and 12 respectively.

Figure 10: CO attainment of course C204

Figure 11: PO attainment through direct method

The parameters such as co-curricular activities, extracurricular activities, alumni survey, graduate exit survey, employer feedback, higher education exams, etc., may be considered for the indirect assessment of PO with the weightage of 20%. The assessment process in continuous evaluation may be done with the following steps:

Step 1: Data collection
Step 2: Data exploration.
Step 3: Result analysis.
Step 4: Determination of required actions.
Outcome assessment will be done once in a year. Continuous evaluation will bring the desired and expected improvements in teaching-learning process as well as assessment methods. During the course delivery, different method are introduced to make learning and teaching more effective and to obtain the desired course outcome attainment.

III. Conclusion

For implementing the OBE system, it is very essential to first determine the desired outcome and then as per the outcome, curriculum, delivery and assessment system and support facilities are to be planned. OBE system goes beyond the ‘structured tasks’. It demands the students to demonstrate his/her skills through more challenging tasks like writing proposals and analyzing case studies that require more complex thoughts, which the traditional system of education failed to involve and achieve over these decades. This paper describes the overview of assessment methods and attainment of course outcome (CO) and program outcome (PO) by providing sample calculation. This paper suggested a sample OBE system to an engineering college for NBA TIER II accreditation.

References
