Improved Attainment through Outcome Based Education and a Case study

K.Pavani 1, Associate Prof in ECE, VJIT
K.Vasantha Babu 2, HOD-ECE, VJIT
Y.Arun 3, Assistant Prof in ECE, VJIT
K.Tarangini 4, Associate Prof in ECE, VJIT

1pavanik@vjit.ac.in
2vkbece@vjit.ac.in
3aruna@vjit.ac.in
4tarangini.kuntla@gmail.com

Abstract------ Outcome Based Education (OBE) is student centered instruction that improves student performance. With outcome based education students may gain more knowledge to improve soft skills and subject to exploring different ideas and innovations. OBE is an active learning- teaching methodology provides solutions for graduate course “Control Systems Engineering”. This paper describes improvement in CO-PO attainment and is successfully implemented for one of the core subject “Control Systems engineering” for engineering graduates at Vidyajyothi Institute of Technology, Hyderabad. One of the best ways to present any course in easy manner for students is achieved by Outcome –Based Education (OBE). OBE definitely builds complete knowledge by simplifying complex topics into small steps by applying OBE Methodologies. The attainment of the skills by the students are measured based on the Program Outcomes (PO’s) specified by the accreditation bodies. Defining the Course Outcomes (CO’s), CO-PO attainment, will modify the traditional teaching methodology to a well planned self-learning and scored good results too that is explained in this paper.

Index terms----Implementation of Outcome-Based Education (OBE), Course Outcomes (CO’s), Program Outcomes (PO’s) and Attainment results.

I. Introduction:

Indian Education System has introduced the Outcome Based Education System through National Board of Accreditation (NBA). OBE has popular and a focus on improving teaching-learning and enhancing delivering skills in engineering curriculum. 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 role of the faculty adapts into instructor, trainer, facilitator, and/or mentor based on the outcomes targeted. However the exiting Teaching-learning process creates a gap between university curriculum and students knowledge. Conducting regular classes only without any practical experiments and designs will not plays a good impact on student’s results. The Program outcomes provides the information about ability of graduates to demonstrate knowledge in fundamentals of Basic Sciences, Humanities and Social Sciences, Engineering Sciences and apply the knowledge in professional core subjects, electives and projects. These outcomes enable the graduates to pursue higher studies and engage in R&D for a successful professional career. Based on CO-PO mapping, we can estimate effectiveness in teaching too. So finally with deep learning and analyzing, Outcome-Based Education reflects a great impact on student’s results as well as in higher studies too. Control Systems Engineering is the one of the most important, interesting subject in electronics engineering stream.

II. Traditional Teaching Approach and Literature Review:

The traditional teaching-learning methodology is in the way of classroom teaching with chalk, board, OHP sheets and revisions. With Outcome Based Teaching-Learning, each subject specified by a course outcome (CO’s), each of the CO’s will addresses one or more program outcomes (PO’s). Lizzie D’cruz Lecturer (Selection Grade), Department of Electronics and Communication Engineering, Dr. B. R. Ambedkar Institute of Technology, Port Blair, Andaman and Nicobar Islands, India presents CO , PO attainment for VLSI Course for internal & Board Exam results[1]. Course outcomes for digital switching systems will be defined and described by Mark Ovinis proposed and described a Comparative Analysis of Attainment of Program Outcomes for Courses with and without the Use of Modern Tools and the usage of modern tools has led to slightly
better attainment [2]. M. Rajendra Prasad developed project based teaching methodology for embedded engineering education to execute projects for better attainment [3]. Joni e. Spurlin presented a procedure to design better engineering education through assessment [4]; this book is written for engineering faculty and department chairs as a practical guide to improving the assessment processes for undergraduate and graduate engineering education in the service of improved student learning. M. Vasantha Lakshmi has defined outcome-based teaching process for microwave and radar [5]. This paper presents an Outcome Based Education and it is compared with traditional approach and attainment of the Course Outcomes (CO’s) with Program Outcomes (PO’S).

III. CO-PO Mapping in VJIT for R-15 Regulation:

Course: Control Systems Engineering
Course Code: A15415

Course Outcome Statements indicating what a student can do after the successful completion of a course. At the end of the course the student should be able to get below points.

CO1: Demonstrate and understand the fundamentals of control systems.
CO2: Obtain the transient and steady state response of both linear and non-linear control systems.
CO3: Determine and use models of physical systems in different forms suitable for use in the analysis and design of control systems.
CO4: Examine the stability of a closed-loop control system
CO5: Ability to represent and analyze control systems by state variable representation.

The program outcomes can be described what students are expected to know and would be able to do by the time of graduation. They are expected to know and would be able to acquire as they progress through the program and those were shown in below table 1.

| Program Outcome | PO 1  | PO 2  | PO 3  | PO 4  | PO 5  | PO 6  |
|-----------------|------|------|------|------|------|------|
| Engineering knowledge | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 |
| PO 7 | Environment and sustainability |
| PO 8 | Ethics |
| PO 9 | Individual and team work |
| PO10 | Communication |
| PO11 | Project management and finance |
| PO12 | Life-long learning |

III.1. CO-PO Mapping for the course control system engineering:

A sample CO-PO matrix for control systems engineering are given in below Table 2. Based on CO statements given. The CO-PO mapping has been done with correlation levels of 3, 2, and 1. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low).

| PO Mapping | CO1 | CO2 | CO3 | CO4 | CO5 |
|------------|-----|-----|-----|-----|-----|
| PO1 | 3   | 2   | 1   | 3   | 2   |
| PO2 | 3   | 2   | 1   | 3   | 2   |
| PO3 | 3   | 2   | 1   | 3   | 2   |
| PO4 | 3   | 2   | 1   | 3   | 2   |
| PO5 | 3   | 2   | 1   | 3   | 2   |
| PO6 | 3   | 2   | 1   | 3   | 2   |
| PO7 | 3   | 2   | 1   | 3   | 2   |
| PO8 | 3   | 2   | 1   | 3   | 2   |
| PO9 | 3   | 2   | 1   | 3   | 2   |
| PO10| 3   | 2   | 1   | 3   | 2   |

In VJIT, the students were assessed through the continuous internal exams and the end semester exams. The internal assessment includes descriptive tests and assignments. After two internal midterm exams, students may have a chance to write betterment exam to reduce absenteeism to improve their internal percentage. Out of three internal mid exams best of two will give the final internal performance of the student. If some components, to attain CO’s/ PO’s are not included in the curriculum provided by the affiliated university, then the institution makes additional efforts to impart such knowledge by covering aspects through “contents beyond syllabus” and “Gap Analysis”. In Vidya Jyothi Institute Of Technology, the gap analysis is processed by taking feedback from the stake holders such as Employers, Alumni, Industry, Senior students, Faculty, Professional Bodies and Department Advisory Board (DAB). Based on the plan of action decided, the department arranges seminars, technical talks, workshops, training programs in Mat lab, NI-Lab view, Cisco Networking, ARM University program and industrial visits etc. Based on the student’s...
IV. Assessment of Course Outcomes:

As per university guidelines 25% weight age is given to internal assessment and 75% weight age is given to external exam assessment. In VJIT Institute the overall attainment is calculated for every course by using direct method. The calculations for over all attainment are shown in below Table.3.

Table.3. Assessment of Course Outcomes

| Course outcome attainment level from internal assessment | CO Attainment | Indirect Attainment | Overall Attainment |
|---------------------------------------------------------|--------------|---------------------|-------------------|
| a. CO i (Mid 1+ Mid 2 + Two Assignments)               | b1           | c1= (0.25 (a) + 0.75 b) | d1= ((1 + (a) + (2+2Y) + (3Z))/ (X+Y+Z)) | 0.8(c1) + 0.2(d1) |

X --- Number of students Opted for Low Option,  
Y --- Number of students Opted for Medium Option,  
Z --- Number of students Opted for High Option.

V. Direct Assessment Evaluation:

Step1: Internal Examinations & Assignments

The First midterm examination shall be conducted for 1-2.5 units of syllabus and second midterm examination shall be conducted for 2.5-5 units. 5 marks are allocated for Assignments (as specified by the concerned subject teacher) – first Assignment should be submitted before the conduction of the first mid, and the second Assignment should be submitted before the conduct of the second mid. The total marks secured by the student in each midterm examination are evaluated for 25 marks.

Step 2: External Examinations

Total Duration: 3 Hours  
Total Marks: 75

Minimum Expected Marks for Pass: 26M (35% of Maximum Marks 75)  
Minimum Expected Marks for course Attainment: 45M (60% of Maximum Marks 75)  
After completion of course by using defined Course Outcomes (CO’s), attainment levels, the direct attainment will give the information about CO attainment. For the academic year (2015-2019) the CO attainment is calculated for Control System Engineering course and that is shown in Table.4.

Table.4. External Assessment

| S.No | Assessment | Maximum marks | Threshold level (%) | Co's attainment level Criteria | Attainment level |
|------|------------|---------------|---------------------|--------------------------------|-----------------|
| 1    | Mid Exams + Assignments | 20+5=25 | 60% | At least 50%-59% of attempted students exceed threshold level (60%) marks | 1 |
| 2    | Mid Exams + Assignments | 20+5=25 | 70% | At least 70% of attempted students exceed threshold level (60%) marks | 3 |
| 3    | Mid Exams + Assignments | 20+5=25 | 60% | At least 60%-69% of attempted students exceed threshold level (60%) marks | 2 |

X---Number of students Opted for Low Option,  
Y---Number of students Opted for Medium Option,  
Z---Number of students Opted for High Option.

Table.5. CO internal attainment

| S.No | Assessment of co's | Maximum marks | Co's attainment level criteria | CO's attainment level |
|------|--------------------|---------------|--------------------------------|----------------------|
| 1    | co1,co2            | 75            | At least 50%-59% of attempted students exceed threshold level (60%) marks | 2.766                |
| 2    | co1,co2            | 75            | At least 70% of attempted students exceed threshold level (60%) marks | 2.64                 |
| 3    | co1,co2            | 75            | At least 60%-69% of attempted students exceed threshold level (60%) marks | 2.612                |
The improvement in attainment with teaching methodology under OBE after applying all those methods and after three certification programs students may gain best idea about their future plan as a Engineer and this paper is going to describe improved performance of one student, his academic profile, CO attainment, PO attainment, co-po attainment with direct and indirect methods were shown in below Table.6. And the student name is Bharat Malaviya of 2015-2019 batches from ECE department in VJIT.

Table 6. Academic Profile

| Marks Obtained | 5098/6350 CGPA : 9.21 |
|----------------|-------------------------|
| Credits Obtained | 192/192 Subject Due: 07/0 |

| S. No. | Code | Subject | Int Max | Int Marks | Ext Max | Ext M | Ch1 | Total | Per | ActCr | Edits | Stat | Grade |
|--------|------|---------|---------|-----------|---------|-------|-----|-------|-----|-------|-------|------|--------|
| I/IV SEM |        |         |         |           |         |       |     |       |     |       |       |      |        |
|         |       |         |         |           |         |       |     |       |     |       |       |      |        |
| 1      | A11 001 | English II | 25 | 23 | 75 | 59 | 82 | 82 | 00 | 2.00 | P | O |
| 2      | A11 002 | Mathematics - I | 25 | 25 | 75 | 64 | 89 | 89 | 00 | 3.00 | P | O |
| 3      | A11 003 | Engineering Physics - I | 25 | 21 | 75 | 59 | 60 | 60 | 00 | 3.00 | P | A |
| 4      | A11 004 | E Program ming – I | 25 | 25 | 75 | 55 | 80 | 80 | 00 | 3.00 | P | O |
| 5      | A11 201 | Electrical Circuits | 25 | 18 | 75 | 48 | 66 | 66 | 00 | 3.00 | P | A |
| 6      | A11 004 | Engineering Chemistry | 25 | 25 | 75 | 44 | 69 | 69 | 00 | 3.00 | P | A |

**Result(%) : 82.44**

| S. No. | Code | Subject | Int Max | Int Marks | Ext Max | Ext M | Ch1 | Total | Per | ActCr | Edits | Stat | Grade |
|--------|------|---------|---------|-----------|---------|-------|-----|-------|-----|-------|-------|------|--------|
| I/IV SEM |        |         |         |           |         |       |     |       |     |       |       |      |        |
|         |       |         |         |           |         |       |     |       |     |       |       |      |        |
| 1      | A11 005 | English II | 25 | 24 | 75 | 51 | 75 | 75 | 00 | 2.00 | P | A+ |
| 2      | A12 006 | Engineering Graphi cs | 25 | 25 | 75 | 38 | 88 | 83 | 00 | 3.00 | P | A |
| 3      | A12 007 | Engineering Physics II | 25 | 25 | 75 | 47 | 57 | 82 | 82 | 00 | 3.00 | P | O |
| 4      | A12 006 | Mathematics | 25 | 25 | 75 | 50 | 75 | 75 | 00 | 3.00 | P | A+ |

**Result(%) : 77.94**

| S. No. | Code | Subject | Int Max | Int Marks | Ext Max | Ext M | Ch1 | Total | Per | ActCr | Edits | Stat | Grade |
|--------|------|---------|---------|-----------|---------|-------|-----|-------|-----|-------|-------|------|--------|
| I/IV SEM |        |         |         |           |         |       |     |       |     |       |       |      |        |
|         |       |         |         |           |         |       |     |       |     |       |       |      |        |
| 1      | A13 009 | Mathematics III | 25 | 25 | 75 | 43 | 75 | 10 | 00 | 00 | 3.00 | P | O |
| 2      | A12 503 | C Program ming - II | 25 | 24 | 75 | 74 | 98 | 98 | 00 | 3.00 | P | O |

**Result(%) : 86.79**
Table.7. Results of the Batch 2015-2019 for the course Control System Engineering

| Roll Number | Internal | External | Total |
|-------------|----------|----------|-------|
| 15911A0467 | 20       | 50       | 70    |
| 15911A0466 | 18       | 42       | 60    |
| 15911A0468 | 17       | 49       | 66    |

Table 8. Course End Survey Form From in VJIT

VI. Course End Survey Form for the course CSE:
The Course End Survey Form for all subjects can be collected from students after successful completion of the B.Tech in VJIT and the respected faculty will take care about that work. The course End Survey form for Control System Engineering is shown in below Table 8.
VII. PO Attainment through direct Method:
The PO Attainment of individual student through direct and indirect method can be evaluated after the completing their program. All these works have to be done under the guidance of Department Advisory Board (DAB) in VJIT. In this regards The PO attainment for the student Bharath of roll number 15911A0464 is shown below Table 9.

| Course Code | Student Name | Course Name | Designation/Assoc Professor |
|-------------|--------------|-------------|----------------------------|
|              |              | CSE         | Assoc Professor             |

**Table 9. PO Attainment of the student Bharath of roll number 15911A0464**

| Course Code | Course Name | Designation/Assoc Professor |
|-------------|-------------|----------------------------|
| 101         | English     | Assoc Professor             |
| 102         | Mathematics | Assoc Professor             |
| 103         | Engineering | Assoc Professor             |
| 104         | Engineering | Assoc Professor             |
| 105         | Engineering | Assoc Professor             |
| 106         | Computer    | Assoc Professor             |
| 111         | Workshop    | Assoc Professor             |
| 201         | Mathematics | Assoc Professor             |
| 202         | Probability | Assoc Professor             |
| 203         | Switching   | Assoc Professor             |
| 204         | Electric    | Assoc Professor             |
| 205         | Electronic  | Assoc Professor             |
| 206         | Signals     | Assoc Professor             |
| 209         | Pee         | Assoc Professor             |
| 210         | Electronic  | Assoc Professor             |
| 211         | Pulse       | Assoc Professor             |
| 212         | Environmental| Assoc Professor          |
| 213         | Electrical  | Assoc Professor             |
| 214         | Digital     | Assoc Professor             |
| 301         | Control     | Assoc Professor             |
| 302         | Control     | Assoc Professor             |
| 303         | Antennas    | Assoc Professor             |
| 304         | Analog      | Assoc Professor             |
| 305         | Linear      | Assoc Professor             |
| 306         | Managerial  | Assoc Professor             |
| 307         | Human       | Assoc Professor             |

**Notes:**
- **PO:** Program Outcomes
- **PO Attainment:** Percentage of students achieving PO within the program
- **PO Attainment Table:**
  - **Course Code:** Identifies the course
  - **Course Name:** Describes the course content
  - **Designation/Assoc Professor:** Identifies the professor associated with the course

**Journal of Engineering Education Transformations, Volume 33, January 2020, Special issue, eISSN 2394-1707**

**Vidya Jyothi Institute of Technology**

**Faculty Name:** K. PAVANI

**Course Code:** A15415

**Course Name:** CSE

**Student Name:** Bharath Malaviya

**Roll No:** 15911A0464

**Academic Year:** 2017-2018

**Semester:** 1

**Batch:** 2015-2019

| CO Number | To what extent do you feel that you have learn | Slight (low) | Moderate (medium) | Substantial (high) |
|-----------|-----------------------------------------------|--------------|-------------------|--------------------|
| CO1       | Demonstrate and understand the fundamentals  | 3            |                   |                    |
| CO2       | Obtain the transient and steady state resp.   | 3            |                   |                    |
| CO3       | Determine different forms suitable for use in | 2            |                   |                    |
| CO4       | Examine the stability of a closed-loop control | 3            |                   |                    |
| CO5       | Ability and analyze control systems by state | 2            |                   |                    |

**Table 9: PO Attainment of the student Bharath of roll number 15911A0464**

| Course Code | Course Name | Designation/Assoc Professor |
|-------------|-------------|----------------------------|
| 101         | English     | Assoc Professor             |
| 102         | Mathematics | Assoc Professor             |
| 103         | Engineering | Assoc Professor             |
| 104         | Engineering | Assoc Professor             |
| 105         | Engineering | Assoc Professor             |
| 106         | Computer    | Assoc Professor             |
| 111         | Workshop    | Assoc Professor             |
| 201         | Mathematics | Assoc Professor             |
| 202         | Probability | Assoc Professor             |
| 203         | Switching   | Assoc Professor             |
| 204         | Electric    | Assoc Professor             |
| 205         | Electronic  | Assoc Professor             |
| 206         | Signals     | Assoc Professor             |
| 209         | Pee         | Assoc Professor             |
| 210         | Electronic  | Assoc Professor             |
| 211         | Pulse       | Assoc Professor             |
| 212         | Environmental| Assoc Professor          |
| 213         | Electrical  | Assoc Professor             |
| 214         | Digital     | Assoc Professor             |
| 301         | Control     | Assoc Professor             |
| 302         | Control     | Assoc Professor             |
| 303         | Antennas    | Assoc Professor             |
| 304         | Analog      | Assoc Professor             |
| 305         | Linear      | Assoc Professor             |

**Notes:**
- **PO:** Program Outcomes
- **PO Attainment:** Percentage of students achieving PO within the program
- **PO Attainment Table:**
  - **Course Code:** Identifies the course
  - **Course Name:** Describes the course content
  - **Designation/Assoc Professor:** Identifies the professor associated with the course

**Journal of Engineering Education Transformations, Volume 33, January 2020, Special issue, eISSN 2394-1707**

**Vidya Jyothi Institute of Technology**

**Faculty Name:** K. PAVANI

**Course Code:** A15415

**Course Name:** CSE

**Student Name:** Bharath Malaviya

**Roll No:** 15911A0464

**Academic Year:** 2017-2018

**Semester:** 1

**Batch:** 2015-2019

| CO Number | To what extent do you feel that you have learn | Slight (low) | Moderate (medium) | Substantial (high) |
|-----------|-----------------------------------------------|--------------|-------------------|--------------------|
| CO1       | Demonstrate and understand the fundamentals  | 3            |                   |                    |
| CO2       | Obtain the transient and steady state resp.   | 3            |                   |                    |
| CO3       | Determine different forms suitable for use in | 2            |                   |                    |
| CO4       | Examine the stability of a closed-loop control | 3            |                   |                    |
| CO5       | Ability and analyze control systems by state | 2            |                   |                    |
Table 10. PO Direct Attainment results of Bharath of roll number 15911A0464:

| Student name | Bharath Malaviya | Roll no. / Reg. No. | B.Tech | Batch | 2015-2019 |
|--------------|------------------|---------------------|--------|-------|-----------|

Vidy Jyothi Institute Of Technology (An Autonomous Institution) Department Of Electronics And Communication Engineering Program Outcomes/Program Specific Outcomes Survey Form

Table 11. Program Outcome Survey Form

VIII. PO Attainment results through indirect method:

VIII.1. Analysis of Exit Survey Data:
Analysis of Exit survey data was carried out through questionnaire form in VJIT has collected after completion of final 8th semester. Out of the total 20% weightage allotted for indirect method, 10% is taken from the Exit survey. 5% weight age allotted for Faculty survey and 5% for Course completion survey. The course end survey for the student Bharat is already shown in chapter VI and results also presented. Now the Program outcome using exit survey data in VJIT is shown in below Table. 11. and in Table 11.1.

Table 11.1. Program Outcome Survey Form

IX. Conclusion:
This paper presents complete CO attainment and PO Attainment of the course Control Systems
Engineering and the course B.Tech-ECE of the student M. Bharath of Roll No 15911A0464 for the both internal & Board Exam results using various surveys by using indirect and direct methods. Study reveals that although result was 97% for the course CSE, the attainment was less for CO3 & CO5. This analysis will help the faculty to plan new strategy for delivery, assessment and students involvement is also more important to improve practical knowledge. In Vidy Jyothi Institute of Technology, students can able to access, E- Journals (IEEE explore), SONET CD’S for core subjects like EDC, COMMUNICATINS (it includes both AC and DC), STLD, MPMC and MICROWAVE ENGNNEERING, and Students are encouraging with Project based learning and Eletronics and communication Engg department is organizing many training programs for students like Ni Lab view, ARM university program, Modelsim, Machine Learning with Mous and in VijT placement and training programs were running in semester breaks to provide placement for Students in both software and core side. For that reason only Mr. Bharath attainments shows improvements compared to traditional methods.

References:

[1] Lizzie D’cruz Lecturer (Selection Grade), Department of Electronics and Communication Engineering, Dr. B. R. Ambedkar Institute of Technology, Port Blair, Andaman and Nicobar Islands, India: Transition from Traditional to Outcome Based Education- A Case Study. IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320–7388, p-ISSN: 2320–737X Volume 7, Issue 4 Ver. I (Jul - Aug 2017), PP 38–45 www.iosrjournals.org

[2] Mark Ovinis, Universiti Teknologi PETRONAS, Malaysia proposed A Comparative Analysis of Attainment of Program Outcomes for Courses with and without the Use of Modern Tools. 10.1051/matecconf/201822506022UTP-UMP-VIT

[3] M. Rajendra Prasad developed project based teaching methodology for embedded engineering education to execute projects for better attainment. Journal of Engineering Education Transformations, Volume 30, No. 3, January 2017, ISSN 2349-2473, eISSN 2394-1707.

[4] M. Rajendra Prasad, D. Krishna Reddy, Computer Based Teaching Methodology for Outcome-Based Engineering Education, 6th IEEE International Conference in Advanced Computing (IACC-IEEE Xplore), 2016.

[5] Designing Better Engineering Education through Assessment: A Practical Resource for Faculty and Department Chairs on Using Assessment and ABET Criteria to Improve Student Learning by Joni Spurlin (Editor), Sarah A.