Special Issue of National Conference NCIEME 2016 Organised by Rajarambapu Institute of Technology and Walchand College, Sangli ISSN 2394 - 1707

Evaluation of Culminating B.Tech project (CBP) using assessment rubrics and mapping

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***Abstract* - Culminating B.Tech project (CBP) is an Essential and Crucial part of every engineering Student. The main purpose of these culminating projects is to explore the knowledge which is acquired by the student during their studies in whole academic semesters. Students show there capacity and Proficiency by solving the real world and research problems. Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. The goal of this education was to present the knowledge and skills of an older generation to the new generation of students, and to provide students with an environment in which to learn. So the activities should be well organized, planned and continuously improved. We adopted OBE in our curriculum and for the course on project work we have written course outcomes (CO) i.e. at the end of the course the student should be able to satisfy these objectives and they are mapped with the program outcomes (PO). This paper presents a approach for the outcome-based evaluation of engineering culminating project carried by Final Year Students. The evaluation and assessment is carried out on the basis of rubrics written for each phase of the process. The progress of the each phase is assessed by evaluation team and the guide using the assessment mapping which is based on rubrics. Rubrics mapping covers all the inputs for the assessment of each phase. Mapping of CO to PO is done based on these attributes. Percentage of attainment of each objective and outcome are calculated.**

Keywords: **OBE, CO, PO, Culminate project**

I. INTRODUCTION

Culminating B.Tech. Project is having highest credits in Final Year B.Tech. Curriculum. The main objective of **Culminating** B.Tech projects is to apply knowledge of all semesters which they have gained into the Final Year Projects. **Culminating** B.Tech project having different areas such as Research Based, Free lancing project, Product or Application Based, Sponsored Category, Inter disciplinary, Robotics, Society Useful Project and conduct a complex, open-ended project to show how proficient they are in solving real world problems.

The Outcome Based Education (OBE) is an education system that emphasis on Outcomes measurement rather than inputs of curriculum covered. Outcomes may include a range of knowledge, skills and attitudes [1]. In order to obtain the desired outcomes, teaching methodology and activities should be well organized, planned and continuously improved. We adopted OBE in our curriculum and for the course on project work we have written course outcomes (CO) i.e. at the end of the course the student should be able to demonstrate these outcomes and they are mapped with the program outcomes (PO). This mapping is known as CO to PO mapping. The PO's of CSE Programme are outlined in Table 1. All Students in the program are expected to acquire these outcomes at the end of their four year of studies through various courses offered in the Bachelor degree in computer science and engineering.

Program Outcomes:

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Table I

Program Outcomes

Sr. no.	Program Outcomes
PO1	Apply knowledge of mathematics, science, engineering fundamentals and computer engineering to solve complex engineering problems.
PO2	. Identify, formulate and analyze real world problems to reach substantial conclusions using computer science and engineering concepts.
PO3	Attain proficiency in analyzing data and designing solutions to the problems.
PO4	Demonstrate principles and practices for software design and development.
PO5	Select and apply appropriate techniques, resources and modern engineering tools to complex engineering activities.
PO6	Demonstrate the knowledge to solve contemporary issues using contextual knowledge.
PO7	Understand the impact of professional engineering solutions in societal and environmental contexts.
PO8	Demonstrate professional skills and ethics
PO9	Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
PO10	Communicate effectively in written and oral form in professional and societal context.
PO11	Demonstrate knowledge and understanding of the engineering and management principles.
PO12	Upgrade the knowledge and skills through continuous learning and higher studies.

Table II

Course outcomes

Sr. no.	**B. Tech Project CO**
CO 1	Interact with customers and identify real world problem statement / identify problems in engineering and technology in selected field of interest.
CO 2	Synthesize and apply prior knowledge of mathematics, computer science and engineering to design and implement solutions to open-ended problems.
CO 3	Design and Develop the software with Software Engineering practices and standards.
CO 4	Use different tools for communication, design, implementation, testing and report writing.
CO 5	Analyzing professional issues, including ethical, legal and security issues, related to software project.
CO 6	Develop better interpersonal communication skills, team work and leadership qualities.
CO 7	Acquire writing and oral presentation skills.

The assessment strategy of final year culminate project is shown in figure 1.

II. IMPLEMENTATION

In last semester i.e. sixth semester of third year, first we form the groups of 3 to 4 students. Then we have taken area of interest from the students. As per the area of interest, HOD, Project coordinator and DPC members allocate the guides to the project groups. In semester 7, we have form the evaluation team of 4 guide containing at least one DPC member. Then in first week of 7th semester, students give presentation on two to three problem statements which they have identified in front of evaluation team. After presentation, evaluation team members either finalize one problem statement or they give comments or revision or modifications or reject it and give the instructions to find new problem statements. After that project group takes action on comment / revisions / modifications suggested by evaluation team.

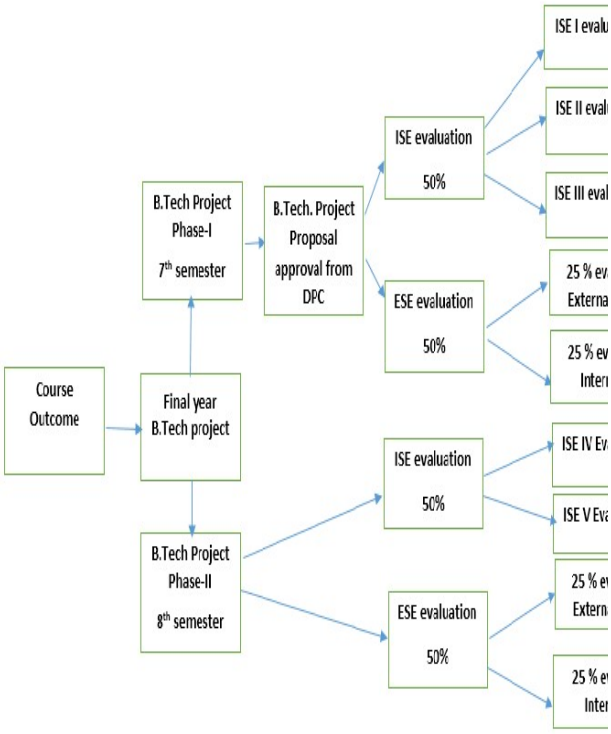

Figure 1. B.Tech. Final Year project assessment strategy

At last if problem statement is finalized then final proposal approval is taken from the evaluation team and that BTech project Proposal approval form is submitted to project coordinator with signature of all evaluation team members.

BTech Project is divided into two phases BTEch project Phase-I and Btech project Phase – II.

In BTech project Phase-I, there are total three evaluations. First evaluation is based on problem statement identification and methodology used and Literature survey/Gather & analyze info from multiple sources which is innovative. Second evaluation is based on SRS. Third evaluation is based on completion of atleast one project modules i.e. its proper design and implementation. We have also check organization of content and readability in the report & Plagiarism through Turnitin plagiarism checker software.

In B.Tech project Phase-II, there are total two evaluations. First evaluation is based on proper implementation of all modules in project and testing of all project modules. Second evaluation is based on changes suggested in previous implemented modules and paper or project presented in any national or international conferences, journals or project competitions.

Rubrics:

First all B.Tech project COs we have divided into 2 or 3 rubrics these are as follows:

Here C1R1 means CO1's rubrics1 and so on. There total 15 rubrics based on 7 CO's of our B.Tech Project.

Table III

Rubrics

CO	Rubric 1	Rubric 2	Rubric 3
CO1	Creativity and Originality in problem statement. (C1R1)	Knowledge of related problem and use of resources and methodology / approach used. (C1R2)	-
CO 2	Domain Knowledge of problem statement (C2R1)	-	-
CO 3	Technical Contents in SRS (C3R1)	Project Coding and Understanding (C3R2)	Proper code development and implementation of all modules in project (C3R3)
CO 4	Partial Project Report writing using tools (C4R1)	Testing of project modules and use of appropriate tools/techniques (C4R2)	-
CO 5	Problem solving abilities to solve legal and security issues (C5R1)	Successfully completed Changes suggested in code Development (C5R2)	-
CO 6	Individual Participation with question & Answer (C6R1)	Paper Presented /Project presented in different competitions (C6R2)	-
CO 7	Presentation skills (C7R1)	SRS document preparation (C7R2)	Preparation of Genuine reports to avoid plagiarism (C7R3)

III. ASSESSMENT

Assessment of project is based on the rubrics which are defined above Table III. Assessment rubrics are written based on Course outcomes for final culminate projects.

Assessment rubrics and their respective levels are shown in Table IV. In each evaluation of final year culminate projects, we have prepare one evaluation sheet based on rubrics. First evaluation of final year culminate projects are based on the problem identification and literature survey is shown in table V. Based on rubrics levels given in the sheet evaluation team ask the questions and put the marks for each individual student. ESE for project phase-I is shown in table VI.

In ESE, we have to split into two parts one is Team Work Evaluation (TWE) and another one is Individual Work Evaluation (IWE). In TWE, internal guide and external examiner asked 15 different questions based on parameters given in the ESE sheet. Also in IWE 5 different questions are asked based on communication style, content of his/her presentation, Knowledge of topic demonstrated during his/her presentation, Understanding and contribution in coding and Quality of answers given to the exam panel. TWE having 25 marks and IWE having 25 marks and total ESE having 50 marks.

Table IV

Sr. No:	**Rubric**	**Unacceptable** (1)	**Below Expectations** (2)	**Meets Expectations (3)**	**Exceeds Expectations (4)**
1	Creativity and Originality in problem statement. (C1R1)	Lack of Creativity and originality in project idea.	Idea of project is somewhat creative and original.	Creativity and originality in project idea.	Project idea is very creative and original.
2.	Knowledge of related problem and use of resources and methodology / approach used. (C1R2)	Literature review in project is incomplete. Bare understanding of the problem, with scarce knowledge of relevant material	Literature review is brief, with insufficient detail. Basic understanding of the problem, but lack appropriate study of relevant material	Literature review is brief but complete. Good understanding of the problem, with Study of relevant material.	Literature review is complete; sufficient detail is provided. Very good understanding of the problem and relevant material
3.	Domain Knowledge of problem statement. (C2R1)	Lack of Domain Knowledge	Poor Domain Knowledge	Good Domain Knowledge.	Excellent Domain Knowledge
4.	Technical Contents in SRS. (C3R1)	Lack of technical contents.	Very poor technical contents.	Good technical contents.	Very excellent technical contents.
5.	Project Coding and Understanding. (C3R2)	Code is not working properly and validations are not used and exception handling is not used properly.	Code is working properly but validations are not used but exception handling is used properly.	Code is working properly and validations are used at some places only and exception handling is used properly.	Code is working properly and validations are used everywhere in project and exception handling is used properly.
6.	Proper code development and	Code is not executed properly and	Code is executed properly but validations are not	Code is executed properly and validations are	Code is executed properly and validations are used

	implementation of all modules in project. (C3R3)	validations are not used and exception handling is not used properly.	used but exception handling is used properly.	used at some places only and exception handling is used properly.	everywhere in project and exception handling is used properly.
7.	Partial Project Report writing using tools. (C4R1)	Frequent errors in spelling and grammar Mostly readable, but a few points are hard to understand	Some errors in spelling and grammar Some errors in spelling and grammar Readable	A few errors in spelling and grammar Readable and easy to understand	Well proofread Clear and easy to understand Graphs and diagrams used appropriately
8.	Testing of project modules and use of appropriate tools/techniques. (C4R2)	-Test cases are not written properly. -Testing tools are not used. -Some test cases are missing.	-Test cases are not written properly. -Testing tools are used. -Some test cases are missing.	-Test cases are written properly. -Testing tools are used. -Some test cases are missing.	-Test cases are written properly. -Testing tools are used. -All test cases are covered.
9.	Problem solving abilities to solve legal and security issues (C5R1)	legal and security issues are not solved	legal issues are not solved but security issues are partially solved	legal issues are not solved but security issues are solved	legal issues are solved completely and security issues are also solved properly
10.	Successfully completed Changes suggested in code Development. (C5R2)	Changes suggested in code are not working properly.	Changes suggested in code are partially working.	Changes suggested in code are working properly and validations are used at some places only and exception handling is used properly.	Changes suggested in code is working properly and validations are used everywhere in project and exception handling is used properly.
11.	Individual Participation with question & Answer (C6R1)	Answer at least one questions Correctly.	Answer most questions correctly Need clarification sometimes	Answer most questions Correctly and concisely.	-Handle difficult questions with ease and Confidence. -Illustrative explanation
12.	Paper Presented /Project presented in different competitions. (C6R2)	-Paper is not presented in any conference or journal. -Project is not presented in any project competition.	-Paper is presented in conference but not selected as best paper. -Project is presented in project competition but not got any prize.	Paper is presented in conference and selected as best paper or Project is presented in project competition and got any prize.	-Paper is presented in conference and selected as best paper and Project is presented in project competition and got first prize.
13.	Presentation	Lack of	Basic	-Good	-Excellent organization

	skills. (C7R1)	confidence and familiarity in some parts of the presentation	organization and preparation -Confident in only some parts of the presentation	organization and preparation -Confident in most parts of the presentation	and preparation -Confident and relaxed in the whole presentation
14.	SRS document preparation. (C7R2)	Very poor SRS document prepared without good design diagrams.	SRS document prepared with design diagrams.	SRS document prepared is good with good design diagrams.	Very excellent SRS document prepared.
15.	Preparation of Genuine reports to avoid plagiarism. (C7R3)	-Frequent errors in spelling and grammar Mostly readable, but a few points are hard to understand	Some errors in spelling and grammar Some errors in spelling and grammar Readable	A few errors in spelling and grammar. Readable and easy to understand	Well proofread Clear and easy to understand Graphs and diagrams used appropriately

Criteria & Points	**Creativity and Originality**	**Knowledge of related problem and use of**	**Presentation skills**

In semester Evaluation for Project Phase I based on problem statement identification and Literature survey:

Table V

In semester Evaluation sheet for project phase I

Enrollment No.	Assigned No.	Student Name	Creativity and Originality (5 Marks) (C1R1)	Knowledge of related problem and use of resources and methodology / approaches used (5 Marks) (C1R2)	Presentation skills & coordination (5 Marks) (C7RT)	Total (15 Marks)
Unacceptable (1)		Lack of Creativity and originality in project idea.		Literature review is incomplete. Bare understanding of the problem with scarce knowledge of relevant material.		Lack of confidence and familiarity in some parts of the presentation
Below Expectations (2)		Idea of project is somewhat creative and original.		Literature review is brief, with insufficient detail. Basic understanding of the problem, but lack appropriate study of relevant material		Basic organization and preparation -Confident in only some parts of the presentation
Meets Expectations (3)		Creativity and originality in project idea.		Literature review is brief but complete. Good understanding of the problem, with study of relevant material.		-Good organization and preparation -Confident in most parts of the presentation
Exceeds Expectations (4)		Project idea is very creative and original.		Literature review is complete; sufficient detail is provided. Very good understanding of the problem and relevant material		-Excellent organization and preparation -Confident and relaxed in the whole presentation

End semester Evaluation for Project Phase I:

Table VI

End semester Evaluation sheet for project phase I

Class & Semester:_____Academic Year: _____ Team No: _____

Team Size: _____ Date: _____

Each metric listed below carries max. **5**Marks: **1**-Bad, **2**-Poor, **3**-Average, **4**- Good, **5**- Excellent (Refer doc for detailed RUBRICS)						**Marks of each student**			
Sr. No:	**Team Work Evaluation (TWE)**	**Marks**	**Sr. No:**	**Individual Work Evaluation (IWE)**		**S1**	**S2**	**S3**	**S4**
1.	Problem identification		1.	Introduces self, eye contact and communication style.					
2.	Literature survey/Gather & analyze info from multiple sources		2.	Slide styles, unities, visuals & content of his/her presentation.					
3.	Innovative & Usefulness		3.	Knowledge of topic demonstrated during his/her presentation.					
4.	Formulate solution/ Problem Description		4.	Understanding and contribution in coding the modules.					
5.	System Requirement Specifications (Functional & Non Functional)		5.	Quality of answers given to the exam panel.					
6.	Design: Data Flow Diagrams & Flow Charts			**IWE TOTAL (25) =**					
7.	Design: UML diagrams& Database			Grand Total of Each Student = (TWE Total + **IWE** of Each Student)					
8.	Use of appropriate tools and techniques for project design			**Roll No:**	**Student Name**	**Grand Total (50)**			
9.	Implementation of the project		1.			----------			
10.	Use of Coding conventions		2.			----------			

11.	Use of appropriate tools/technologies for coding the modules		3.			----------
12.	Testing of the project and use of appropriate tools/techniques		4.			-------
13.	Able to deploy& demonstrate developed modules of the project		5.			--
14.	Quality of results		6.			
15.	Organization of content and readability in the report & Plagiarism		Remarks:			
(e.g. 75/3=25)**TWE TOTAL (25) =**						

Name of: - Guide & Sign: _____External Examiner & Sign: _____ Contact: _____

IV RESULT

After completion of all three ISE presentation in semester 7th and ESE evaluation, we have prepare Co attainment for B.Tech Project phase-I, which is shown in figure 2.After that depending on Co to Po mapping, we have calculated the PO attainment for project phase-I shown in figure 3.

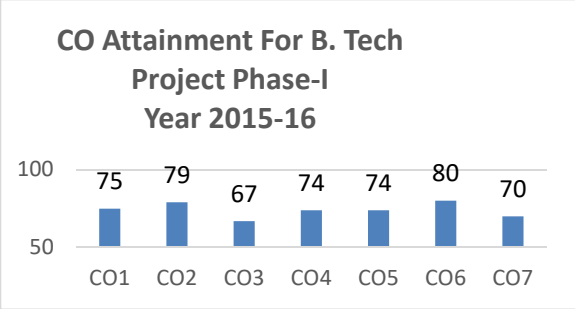

Figure 2. CO attainment of Project Phase I 2015-16

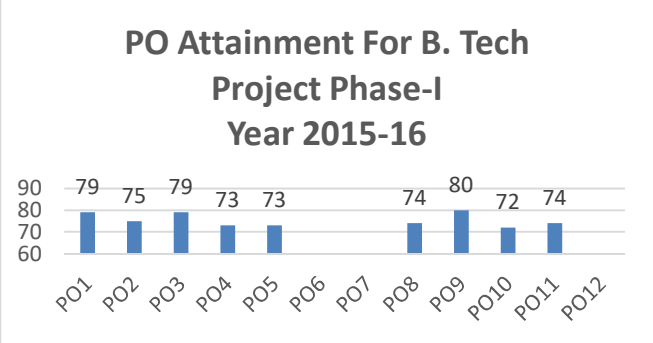

Figure 3. PO attainment of Project Phase I 2015-16

V CONCLUSION

Assessment rubrics are developed and communicated to each External evaluators, project guide and students resulting in uniform assessment which was a very tedious task. This has resulted in improved leaning by students and enhanced participation of both faculty members and students right from the beginning of the project phase. Project Quality get improved

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and they have complete their work in time. Through Culminate Project we could meet all PO except PO 6 and PO 7.

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