

# Measurement of Programme Outcome-h through Course Seminar

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**Abstract** — Measurement of programme outcomes "a-k" is the most challenging part of outcome-based education. Programme outcomes a, b, c, d & e are usually achieved through regular theory and laboratory courses. Similarly outcomes f, g, i & k are achieved through mini projects, course projects and capstone projects, sometimes even through final year one credit course seminar. The measurement of remaining outcomes i.e. h and j demands additional effort from the faculty member to design special activities. Accordingly there is a lot of scope to measure outcomes h and j through conducting course seminars on many technical topics, which are related to "impact of engineering solutions" and "contemporary issues". Hence an attempt was made to measure the impact of engineering solutions, i.e. po-h by conducting course seminar in the subject Mechatronics for V SEM students of Industrial and Production Engineering department during the year 2012-13 and 2013-14. The students worked and presented their work in the form of course seminar in teams. The evaluation of seminar was rubrics based. The seminar prepared by the students benefited them in many ways. The conduct of course seminar activity has led a platform and a basis for the students for many activities like selection of mini-projects, confidently delivering department's pre final year and final year seminar presentation, preparing technical reports, technical papers etc. The overall process of conducting course seminar helped not only students but also the faculty in many ways. The paper below describes on how an attempt is being made to measure programme outcome – h through course seminar in the subject Mechatronics for two consecutive academic years using

proper rubrics and assessment criteria.

**Keywords**—Mechatronics, programme outcomes (PO), course seminar, rubrics, performance indicators.

## I. INTRODUCTION

Course seminar activity for the subject Mechatronics for V semester Industrial and Production Engineering students is being conducted for the last three odd semesters. The 1st attempt was made in 2010-11 odd, without any specific objectives in mind. Here the students presented the course seminar from the topics/articles, which were published in the magazines such as "Electronics for you (EFY)" and related Mechatronics journals. Then, later in 2012-13 odd semester and 2013-14 odd semester, the conduct of course seminar was designed in such a way that it was more specific, systematic and useful for both students and faculties. The measurement of course seminar was rubrics based, consisting of five performance indicators which were based on the focus of measuring program outcome –h. The paper gives an insight on how the course seminar was conducted, details of rubrics used, evaluation criteria and its usefulness to both students and concerned faculty member.

## II. WORK DONE

This part of the paper explains the flow of conduct of course seminar, its initial preparation, rubrics and evaluation procedure.

### A. Preliminary preparation for conducting course seminar:

There are many relevant topics in the area of Mechatronics where students can collect information

through various resources for the seminar. Various groups of 4 students each were formed and every group carried out the literature survey initially by searching topics through various secondary sources such as internet, technical magazines, national and international journals. Selection of the topic was solely at the student/group discretion in consultation with the concerned faculty member.

#### B. Contribution of the faculty member:

The faculty member contributed by guiding each group throughout their course seminar presentation. Importantly students were made to realize the importance of literature survey. Once the topic was finalized, the faculty member along with the guidance of Head of the Department framed proper rubrics for the course seminar which focused on measurement of programme outcome – h [6]. The rubrics consisted of five important performance indicators which are described in "section C" below. These rubrics were explained to students well in advance so that they focussed on these parameters while collecting the required information for the seminar.

The faculty member spent some time with the students before they set out on their own, in explaining them how to write a technical paper and make them realize the importance of doing so. Since the students were not previously exposed to technical paper writing formats special efforts were put by the faculty member to guide them for the same.

The topics presented by the batch 2012-13 were shown as sample topics and explained to the new batch of 2013-14 for clear understanding of course seminar procedure.

#### C. Performance indicators used:

Five different performance indicators were used in the rubrics for measurement of effectiveness of the course seminar which are directly related to the measurement of programme outcome h, indicating "The broad necessary to understand the impact of engineering solution in a global, economic, environmental and societal context" [4]

The performance indicators are as follows: [5][6]

- 1) Recognize the impact of manufacturing and industrial engineering decisions on the local and global environment, community and economy.
- 2) Combine knowledge of potential impacts into design and problem-solving processes.
- 3) Familiarity with national and international publications that describe the impact of technology on society.
- 4) Familiarity with and able to describe the historical development of technology in manufacturing and industrial engineering
- 5) Personal perspective on the importance of engineering in today's world.

**TABLE I MARKS SPLIT UP FOR EACH PERFORMANCE INDICATORS (RUBRICS BASED ASSESSMENT) [5][6]**

|                                                                                                                                            |                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PI: Recognize the impact of manufacturing and industrial engineering decisions on the local and global environment, Community and economy. |                                                                                                                                                                                                                                                                               |
| Exceeds (10 marks)                                                                                                                         | Describes and discusses future of the manufacturing and industrial engineering discipline<br>Can relate how issues of culture impact technology development in India and abroad                                                                                               |
| Meets (7-9marks)                                                                                                                           | Describes and discusses current trends in the manufacturing and industrial engineering discipline<br>Can somewhat relate how issues of culture impact technology development abroad (through personal experience in an international setting or through classroom experience) |
| Progressing (4-6marks)                                                                                                                     | Is somewhat aware of current events in society<br>Is familiar with technology abroad, but does not consider the relationships between culture and technology to be different from those in India                                                                              |
| Below (0-3marks)                                                                                                                           | Is unaware of current events<br>Isn't aware of cultural consideration in technology development abroad                                                                                                                                                                        |
| PI: Combine knowledge of potential impacts into design and problem-solving processes.                                                      |                                                                                                                                                                                                                                                                               |
| Exceeds (10 marks)                                                                                                                         | Is able to explain the importance of combining the knowledge of potential impacts into design and problem-solving processes                                                                                                                                                   |
| Meets (7-9marks)                                                                                                                           | Combines knowledge of potential impacts into design and problem-solving processes                                                                                                                                                                                             |
| Progressing (4-6marks)                                                                                                                     | Shows some shallow consideration of the potential impacts in design and problem solving exercises                                                                                                                                                                             |

|                                                                                                                 |                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Below (0-3marks)                                                                                                | Does not consider potential impacts of design and problem solving to be constraints on the solution                                                       |
| PI: Familiarity with national and international publications that describe the impact of technology on society. |                                                                                                                                                           |
| Exceeds (10 marks)                                                                                              | Reads, compare, analyze and is able to relate the content of periodicals that are relevant to understanding the global and societal impact of engineering |
| Meets (7-9marks)                                                                                                | Reads and is able to relate the content of periodicals that are relevant to understanding the global and societal impact of engineering                   |
| Progressing (4-6marks)                                                                                          | Is aware of the existence of technical periodicals – would know where to look to find them                                                                |
| Below (0-3marks)                                                                                                | Is not familiar with any technical periodicals                                                                                                            |

|                                                                                                                 |                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| PI: Familiarity with national and international publications that describe the impact of technology on society. |                                                                                                                                                           |
| Exceeds (10 marks)                                                                                              | Reads, compare, analyze and is able to relate the content of periodicals that are relevant to understanding the global and societal impact of engineering |
| Meets (7-9marks)                                                                                                | Reads and is able to relate the content of periodicals that are relevant to understanding the global and societal impact of engineering                   |
| Progressing (4-6marks)                                                                                          | Is aware of the existence of technical periodicals – would know where to look to find them                                                                |
| Below (0-3marks)                                                                                                | Is not familiar with any technical periodicals                                                                                                            |

|                                                                                                                                 |                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PI: Familiarity with and able to describe the historical development of technology in manufacturing and industrial engineering. |                                                                                                                                                                                    |
| Exceeds (10 marks)                                                                                                              | Can analyze and explain historically important engineering failures and their impact on society and engineering solutions of future                                                |
| Meets (7-9marks)                                                                                                                | Can analyze historically important engineering failures and their impact on society and engineering solutions of today's world                                                     |
| Progressing (4-6marks)                                                                                                          | Can site some important engineering failures, realizes their impact on engineering solutions of today's world , but does not have significant insight into their impact on society |
| Below (0-3marks)                                                                                                                | Has little or no awareness of significant historical engineering failures and what we have learned from them                                                                       |

|                                                                             |                                                                                                   |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| PI: Personal perspective on the importance of engineering in today's world. |                                                                                                   |
| Exceeds (10 marks)                                                          | Has a personal perspective on the importance of engineering in today's world as well as in future |
| Meets (7-9marks)                                                            | Has a personal perspective on the importance of engineering in today's world                      |
| Progressing (4-6marks)                                                      | Is interested in engineering because of what the discipline offers him/her personally             |
| Below (0-3marks)                                                            | Isn't sure why he/she is studying engineering                                                     |

All the above performance indicators were measured for 10 marks each. If the work of the team exceeded the expectation of the faculty then based on the effort put by each member 10 marks were awarded each, if it met the requirements then 7 to 9 marks were awarded, if it was found progressing then 4 to 6 marks were awarded and finally if the work was below the expected level then the marks were set in the range of 0 to 3.

The concerned faculty member was assisted by another faculty for the purpose of evaluation of the course seminar and the final marks awarded was the result of average of both the faculty marks given individually. The students were awarded marks based on their individual contribution as well as on their effort as a team.

### III. RESULTS AND DISCUSSIONS

This part of the course seminar can be explained as follows:

#### A. Measurement of programme outcome –h:

Programme outcome–h which states "The broad necessary to understand the impact of engineering solution in a global, economic, environmental and societal context" was measured through the course seminar and the above stated performance indicators were used to support this outcome.

The students were asked to collect the relevant necessary information and prepare the technical paper in IEEE format and then present the same as the course seminar based on the areas such as "Effect or impact of Mechatronics product or technology in the global context" or "How Mechatronics technology

has made the human life simpler and easy?" Any topic selected by the student should address the above areas.

After conducting the course seminar the marks awarded by both evaluators was averaged and was awarded to the group. Finally the total average of all the students and the groups were taken for the measurement of programme outcome –h.

#### B. Statistics:

Each batch or group was evaluated for 50 marks separately by both the evaluators. Similarly each individual was also evaluated for 50 marks separately by both the evaluators. Then the average of group marks and the individual marks were added and averaged again to get the final result of the student.

Ex: If a student xyz scores 40 and 45 marks by two different evaluators and his group scores 35 and 40 by two different evaluators then the individual marks of the student is calculated by the following simple formula:

$$FIM = (A+B+C+D) / 4$$

$$FIM = (40+45+35+40)/4$$

$$FIM = 40 \text{ which is now reduced to } 10 \text{ marks.}$$

$$\text{Then FIM of student xyz} = 40/5 = 8 \text{ marks.}$$

Where FIM = Final Individual Marks of student xyz

A= individual marks by evaluator 1

B= individual marks by evaluator 2

C= group or team marks by evaluator 1

D= group or team marks by evaluator 2

When the aggregate of the overall class is considered for the purpose of calculating percentage attainment of programme outcome –h, then it was 77% attainment for the batch 2012-13.

Total percentage attainment of 77 % as evident from fig. 1 above is an appreciable result as the course seminar with rubrics based assessment was conducted for the first time. [7]

The rubrics based assessment is a new type of assessment approach and still needs to be introduced to many of the technical and non-technical universities across India.

When rubrics based assessment is followed, then there will be a clear understanding in the assessment criteria. It's beneficial for both students and faculty. Students can understand, what is expected from them in the course seminar preparation through rubrics, where as faculty can clearly distinguish between the marks and distribute it according.

For the year 2012-13, the minimum marks secured in course seminar by an individual has been 3, and maximum marks seminar by an individual has been 10. Fig. 2 graph shows clearly that 6 students secured 10/10 marks and class average is around 7.7/10. There was some decrease in the total percentage attainment for the next batch i.e. the attainment is reduced to 64.74% as in Fig. 3, due to some reasons

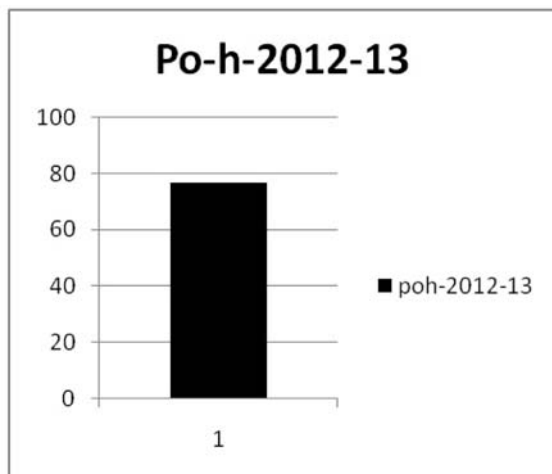


Fig 1. Showing the percentage attainment of po –h for the batch 2012-13.

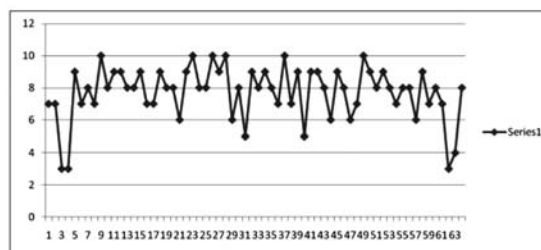


Fig 2. Showing the marks distribution of entire class ranging from 3-10.

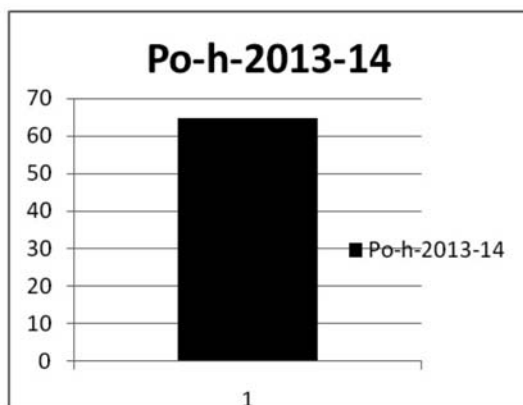


Fig 3. Showing the percentage attainment of po -h for the batch 2013-14.

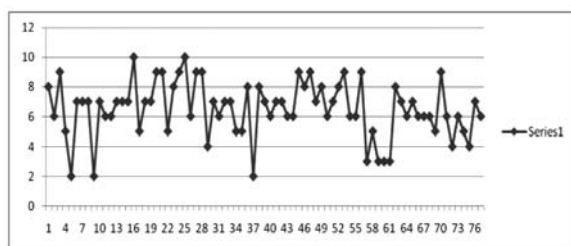


Fig 4. Showing the variations in marks for batch 2013-14.

like the subject was changed from Mechatronics to Mechatronics and PLC with the addition of tutorials to the subject. Along with course seminar preparation, the students were given more number of assignments on PLC problems too. Also the expectation level of the faculty member was increased in the area of collecting literature survey and writing technical paper.

This percentage attainment is expected to increase by 10-15% in the next academic year, with more clear understanding of the procedure.

For the year 2013-14, the minimum marks secured in course seminar by an individual has been 2, and a maximum marks secured by an individual has been 10. As Fig. 4 shows clearly that two students secured 10/10 marks and 9 of them secured 9 marks out of 10 and class average was around 6.5/10. [8]

### C. Benefits of course seminar to students:

The students of semester V have been benefited in the following ways from the course seminar.

- The students were made to search for various different sources from where they can get relevant information on their chosen topic; hence students started getting familiarized with national and international journals. They also started reading many technical papers from various magazines.
- The students got exposed on how to write a technical paper; it was like basic foundation for these students regarding technical paper writing. For the first time they made an attempt to write technical paper in the IEEE format.
- The course seminar helped students to gain extra knowledge about the subject apart from the syllabus and students were able to link the subject well with the seminar; hence the concepts of the subject were clearer to them as they worked hard for the course seminar.
- Students came to know how Mechatronics plays an important role in today's world both in societal and industrial context.
- Each student had an opportunity to work in a team, gather relevant information, share it and present it to the class. Hence course seminar gave a chance to prove them a team player and improve their communication skills.
- 10 out of 36 groups presented their course seminar topics in State level and National level paper presentation competition across different engineering colleges and bagged 1st and 2nd prizes during the academic year 2012-13 and 2013-14.
- As Industrial and Production Engineering department has introduced automation theme based mini projects at 6th semester level, the literature survey conducted by students for course seminar has helped them in selecting projects for this theme and two batches from 2013-14 have carry forwarded their course seminar work in converting into mini project where the theme was automation and successfully completed it with a working model.



*D. Benefits of course seminar to faculty:*

Even the concerned faculty member was benefited in some of the following ways.

- Course teacher/ faculty came to know about different types of Mechatronics applications in today's technology. Helped in keeping up to date with the subject and also had an opportunity to guide different topics and even exchange knowledge from the students.
- Due to this course seminar, which was rubrics based, there was scope to measure the programme outcome-h otherwise measuring outcome-h through regular theory or laboratory course is a difficult task.
- Faculty was able to deliver theory classes better for 2013-14 batch students, as there were more number of examples and applications to be discussed in Mechatronics, which were extracted from course seminar of 2012-13 batch students.
- This activity helped the faculty to pick some feasible topics from course seminar and convert them into mini projects and guide accordingly.

*E. Topics covered in course seminar*

During the year 2012-13 and 2013-14 odd semester, thirty-six different topics were presented in the course seminar. List of some important topics are mentioned below.

- Compatibility of Mechatronics devices in MRI systems.
- The automatic parking assistance in cars.
- Automatic windshield wiper system.
- Importance of Mechatronics in bio-medical engineering.
- Defect sensing conveyor.
- Automatic fritter making machine.
- Sensotronic brake control system

Similarly the students presented many other interesting topics. (Refer Appendix II)

All the topics mentioned above are not the direct extract of any one technical paper. The students in a batch of four have collected information regarding the selected topic through net, magazines, national

and international journals. Then they exchanged their ideas regarding the topics, discussed in the groups and then with the help of this literature survey, they wrote a technical paper, concluded in their own ways and finally presented it as a course seminar.

#### IV. CONCLUSIONS

As mentioned in the paper earlier the overall attainment of outcome-h is 77% for the year 2012-13 and 64.74% during the year 2013-14. In the first attempt of conducting course seminar in a technical subject like Mechatronics, 77% attainment is an appreciable achievement by students. The attainment has reduced by nearly 12% during next attempt may be due to high expectations by the faculty members in the areas of literature survey and focusing the impact of technology on the societal context.

It was found during the course seminar that the student focused well on how the Mechatronics product or new invention in the field of Mechatronics is having an impact on the society and how it has made the human life simpler, easy and enjoyable.

Overall it was a great experience for these two years to conduct course seminars, which were rubrics based, as it helped both students and faculty member. It helped to have an all round development in the area of Mechatronics. Also another important factor is that, the course seminar helped to measure the outcome-h.

#### V. FUTURE SCOPE

- Along with outcome-h other outcomes such as g, i and j can also be measured by preparing appropriate rubrics.
- Each performance indicators mentioned in the rubrics can be measured separately and accordingly attainment of each performance indicator can also be calculated.

#### ACKNOWLEDGMENTS

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seminar, from preparing and selecting appropriate rubrics to measuring the outcome–h has helped faculty to boost the confidence in the system. The conduct of course seminar would have been a difficult task without his support and valuable guidance.

Thanks to Madhusudhana HK Asst.Professor and J. Satish Asst.Professor for assisting in the evaluation process.

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#### APPENDIX I

The following are the topics chosen by 16 batches of students for the course seminar during the year 2012-13.

| BATCH NO | SEMINAR TOPICS                                       |
|----------|------------------------------------------------------|
| B1       | Digital Sphygmomanometer                             |
| B2       | A Device to Prevent Collision Between the Trains     |
| B3       | Robot Mules Helping on War Front                     |
| B4       | The Automatic Parking Assistance                     |
| B5       | Scarab Merlin Cleaner                                |
| B6       | Compatibility of Mechatronics Devices in MRI systems |
| B7       | Industrial Automation                                |
| B8       | Virtual Surgery                                      |
| B9       | Automatic Window Cleaning Robot                      |
| B10      | Fuzzy Logic Controller for Washing Machine           |
| B11      | Projectors in Theatres                               |

|     |                                                                                        |
|-----|----------------------------------------------------------------------------------------|
| B12 | Automatic Windshield Wiper System                                                      |
| B13 | Laser Tracker                                                                          |
| B14 | A DSP Based Echo Canceller using Adaptive Filters                                      |
| B15 | Sensors used in Latest Gadgets                                                         |
| B16 | Assembling Wheels to Continuously Conveyed Car Bodies using Standard Industrial Robot. |

#### APPENDIX II

The following are the topics chosen by 20 batches of students for the course seminar during the year 2013-14.

| BATCH NO | SEMINAR TOPICS                                                     |
|----------|--------------------------------------------------------------------|
| B1       | Intelligent hotel management system                                |
| B2       | Importance of Mechatronics in bio-medical engineering              |
| B3       | Voice operated wheel chair                                         |
| B4       | Defect sensing conveyor                                            |
| B5       | Home security system                                               |
| B6       | Hands free driving using voice recognition technique in automobile |
| B7       | Intelligent traffic light flow control system                      |
| B8       | Automatic fritter making machine                                   |
| B9       | Automatic irrigation system using solar power                      |
| B10      | Converting sign language to speech                                 |
| B11      | Cash box guard                                                     |
| B12      | Robot treats brain clots with steerable needles                    |
| B13      | Sensotronic brake control system                                   |
| B14      | Hyper redundant robots                                             |
| B15      | Advancement of Mechatronics in medical field                       |
| B16      | Automatic water sprayer used in agriculture                        |
| B17      | Fault detection in aerospace applications                          |
| B18      | Robotic pants for the paralysed                                    |
| B19      | Blind walk tool                                                    |
| B20      | Backup generator for elevator                                      |