

# Effect of Industry Electives and Interdisciplinary Courses on Outcome based Engineering Education

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## ABSTRACT

Engineering curriculum in India is divided into core branches like Electronics, Mechanical, Electrical, Civil, Computer Science, etc. There are some topics of study, that are applicable to different branches and knowledge of different engineering disciplines are necessary for the practical application of these subject. As the industry is developing the applications based on various research works and based on customer needs the students are expected to know various aspects of technology as per the industry needs. An interdisciplinary subject is one which can be taught to students of different branches and streams and it includes the subject matters related to different disciplines. Industry electives are the ones that are introduced by the industry to the engineering curriculum.

This paper highlights the importance of industry elective and interdisciplinary subjects and projects in engineering curriculum. Here we discuss the case studies of some industry electives introduced in an autonomous curriculum and the interdisciplinary subjects that are introduced. Also the need of interdisciplinary project is discussed.

**Keywords:** Interdisciplinary Subjects, Industry Electives, Engineering Education, Out Comes.

## INTRODUCTION

The current economic situation as well as the future well-being of the country triggered the need for enhancing the acceptability of Indian industrial products in the international market. Also due to the focus on developing the products in India, the focus on the curriculum design and development is to be re looked. This has introduced new challenges to engineering educators to develop courses that are relevant to the needs of the nation and its industry. Also the students should be acceptable even in the international market. Students should be given the tools and the general knowledge of various applications and technologies that the industries are working on. The engineering graduate who enters an Information Technology (IT) industry will work on IT technology, this create the need on knowing the recent developments in IT for any engineering graduate irrespective of his branch of engineering. The competencies acquired by the students are expected to be in line with the needs of the industry. The program outcomes also need to be in line with the industry expectations.

Engineering colleges will have the branches like Computer Science and related branches, Electronics, Electrical, Mechanical, and Civil. Some colleges may offer some other courses like Biotechnology,

Textile, Mining, Printing technology etc. Physics and Chemistry will be taught only at first year for one semester. Mathematics will be a paper for three or four semesters.

### **Need of Industry Electives**

An industry elective is a subject that is focused to the need of the IT or any other industry. An example for this is cloud computing as a technology domain or business analytics as an application domain, that can be taught to the students of Computer Science and Engineering branch. Also an industry elective may be defined as a subject that is introduced in collaboration with an industry. The technology being introduced should cater to the major set of employers. In a paper [2] it is quoted that, the ICT curriculum is out-of-sync with ICT development in the real world and the academic subjects are outdated. This study is carried out in Australian Universities in the Computer related branches. Also authors have observed that 1/3<sup>rd</sup> of the ACM preferred electives are offered in the universities. This leads to a gap between industry and academia. Also it is observed that the curriculums of various universities are having less of inter disciplinary courses and industry electives [3].

### **Need of Interdisciplinary Subjects**

Interdisciplinary courses will give the basic knowledge of related subjects to the students who are from different core branches. The circuit branches of engineering are inter related. Each branch will have some subjects of the other branch. Some of them are Computer Science students studying Circuits, Signal processing, electronics engineering students studying C++, Databases etc. These subjects will have applications in the relevant areas of the disciplines.

The subjects which are common to various branches can be made as an interdisciplinary elective subject and student of any branch can opt for that elective. NITs and the academically autonomous colleges have the concept of open electives. These are the subjects which can be offered to the students of different branches. Mechatronics is one subject that can be offered to the students of circuit branches and mechanical branch <sup>[1]</sup>. The engineering colleges can design some set of subjects and it can be offered to the students from different branches. Computer science students, who want to work in embedded systems, need to know the VLSI and chip design. A student from electronic branch, who wishes to build a smart vehicle, need to know the mechanical engineering concepts.

Various Universities in India are offering interdisciplinary postgraduate courses. M.Tech in Nanotechnology is one such course which is run by some government and private organizations. IISc Bangalore had established a nano research center. But more courses are to be introduced in the afflicted colleges.

### **A COURSE ON NANOTECHNOLOGY AS CASE STUDY**

Nano-technology courses offer knowledge and training on the development and modification of devices with atomic precision. The dimension of particles is of the order less than 100 nanometers. It is an interdisciplinary subject that integrates the study of Bio- informatics, Bio-technology, Physics, Chemistry as well as other disciplines. The scope and application of nanotechnology is wide ranging and therefore many institutes are now introducing degree courses in

this field at the graduate and post graduate level. Being an interdisciplinary subject, students with a degree in nanotechnology can find employment and research opportunities in a varied number of fields. The areas where a nano-technologist can seek employment include agriculture, food and beverage, genetics, biotechnology, Space research, forensic science, environment industry and medicine.

The course would equip graduates with the skills to make a successful career in the new industries where reduced dimensionality plays a critical role in their products. It is designed as series of lecture modules covering the technologies used to design, realize and analyze the nanoscale devices, materials and systems, coupled with the general and technology management. These are supported by project work, undertaken on both group and individual basis and conducted in close collaboration with industry. Graduates emerge trained in a wide range of technical and management skills and with a sharp appreciation of the relevance of the subject to industrial needs.

Some of the industries which will employ the nanotechnology graduates are:

- Health Industry research and consulting- pharmaceutical, medical, agriculture, food and beverage, environment industries.
- Research and development in government, universities and private research institutes
- Education and academic
- Entrepreneurial, management and investment advisors in biotechnology and research and development industry.
- Product development and advising.
- Communication and media, interfacing of new technologies.
- Many new industries emerging as a result of advances in nanotechnology

Nanotechnology can be offered as a course for the graduates of Computer Science, Electronics, Mechanical, Physics, Chemistry, Biotechnology. If a department of nanotechnology needs to be established, it needs the experts from the above mentioned branches to work together. Nanotechnology has its application in various fields, so instead of making it as a core branch, it is beneficial if it is considered as inter disciplinary course in engineering curriculum.

In under graduate level interdisciplinary subject can be made as a subject, which can be opted by the students of various branches where the concept is applicable. It can be a 4 credit course or even 8 credits may be given by dividing the subjects in to two semesters. The first subject will teach the fundamentals of Nano technology and the latter one will discuss the application in various fields. A typical way of grading the course may be as follows.

- Assignments
- Lab Projects (group/individual)
- Two Tests
- Final Exam

If the course is being taught as a subject for undergraduates, the Nanotechnology can be a course of 4 or 8 credits. This subject should incorporate the extracts from the above mentioned courses. It may be offered in fifth, sixth or seventh semester to enable the students to carry out suitable project in eighth semester.

## **INTERDISCIPLINARY PROJECTS**

Encouragement need to be given for taking up interdisciplinary projects. Students of various branches can be grouped together and work for a single project in their final year of engineering. This will leverage the students for the innovation of new products. Involvement of the student from different branches will reduce the overhead of knowing the details of other branch aspect of the project. This can be illustrated with following example - If a bionic chip needs to be fabricated then a student from Biotechnology can work in the identification of cells and their properties. Student of Computer science can design the algorithms on which the chip should work and can design the data structure that need to be handled by the cells. An electronic student can work on how these cells can be fabricated in to a chip so that it functions as per the requirement. There should be a provision in University norms for the students of different branches to form a project team and work for one project. Each student may be assigned a guide in his department who can be called as co guide, in addition to a main guide who may be a faculty in any related branch.

*Studsat* project is an example for inter disciplinary project that involved students from Computer major and electronics major. The challenge here is to demonstrate the work as a single project. In the present scenario, the work is being shown as two or more independent modules. Modifications may be done in the system to evaluate this as a one single project by involving the examiners of the related branches.

## **INDUSTRY ELECTIVES**

Industries related to various streams of engineering have varied requirements. Among them many of the requirements are common across the industries. Some companies will come forward to include the topics related to the need of industry in to the curriculum. The companies will have expertise in the topic so that they can train the faculties. This also has a limitation of vendor lock in, in which the company may have an agreement to sign for an agreement to use the proprietary software.

### **Case Studies**

Business Intelligence, Android Programming, Cloud Computing, Software testing are some of the elective that are introduced by the industries for the computer major streams. Aircraft design, robotics, internet of things, are the subjects that may be introduced for the mechanical and electronics branch students.

To introduce these subjects the industry will propose a syllabus as per the college norms, present this in the board of studies. The committee will look at the relevance and applicability of the subject. Then the subject will get introduced in the curriculum. The company will conduct a training program for few of the faculty. The trained faculty will conduct the classes for the students. In another mode of operation, the employee of the industry will come to the college and train the students in the role of guest faculty. In the first approach, the institute gets the benefits of faculty getting trained to propagate the knowledge further.

The goal of introducing these subjects is to align the outcome of the engineering college to the industry needs in addition to focusing the students towards research. The major expectation of the

industries from the students is being strong in fundamentals. This is attained by the core engineering subjects that are framed by the academia as per the ACM international standard of syllabus framing. The additional knowledge of the current developments is obtained by the additional electives. The elective introduced should either related to currents application trends or the research trends. This aligning the program out comes to the industry needs and building competency among the students to be successful engineers.

The observed outcomes from introducing the courses like Business Intelligence is that, most of the service companies are working on the BI related projects. The students working in such companies feel the benefit of studying the subject in the college; these makes their training process easy and are able to visualize the business solution to be built with ease than other students. The more number of program outcomes are achieved with the introduction of these subjects as they provide technical inputs, enable the students to understand and solve the real life engineering problems.

The subjects like Android programming make the students to attempts for the problem solving as individuals. This creates the entrepreneurship skills and leadership qualities that are few of the expected outcomes of the engineering program. It is observed that the students start ups due this knowledge. App development is the currents trend as it needs less investment and has a good customer base.

## CONCLUSION

Interdisciplinary subjects at undergraduate levels leverage the students for innovation by exploring the various advancements of the technology. It will lead to interdisciplinary projects which can benefit the society and technological development which in tern leads to better product development. Industry electives focus the students to the recent developments in the industry and train them for the current need. This bridges the gap between industry and academia.

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