Engineering practices lab: A multidisciplinary laboratory course.

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***Abstract*— Engineering Practices is a Laboratory course designed uniquely to fit all aspects of engineering, mainly mechanical, electrical and electronics. Today is the world of engineering, specially the conglomeration of all streams of engineering. Hence it is better for upcoming engineering graduates to learn some basics from all streams. Though there are many theory classroom courses, still lack of practical knowledge is also to be considered. Engineering Practices lab is a unique course which can overcome above mentioned drawback.**

The Engineering Practices lab fits in properly with traditional Workshop Practices Lab for freshmen and the same was utilized even at BVBCET. Efforts of 1 year have been put to come up with better content in the syllabus. This paper gives an idea of what are the contents of the Engineering Practices Lab and how they are relevant for engineering graduates.

Students have enjoyed and highly appreciated this course because of its uniqueness. Care has been taken to include all main aspects of engineering namely mechanical, electrical and electronics. Attempts are being made to include robotics in to its curriculum to make much more interesting and relevant.

Keywords*— *Multidisciplinary, Engineering Practices

I. INTRODUCTION

Today in the world of rapid engineering and accumulation of all engineering streams, it is very difficult to say that a Mechanical Engineer will sustain only on the knowledge of pure mechanical engineering. Almost all products which we come across are the conglomeration of different streams of engineering in different proportions. A simple example of a modern car can be taken into consideration. In olden times, a car was something which was purely mechanical stream oriented. But today a car consists of much electrical equipment like motors for starting the vehicle, wiper mechanism, power window etc. Many electronic equipment like CD or MP3 player, automatic choke, etc. Of course computer engineering stream plays an important role viz., GPS, Automatic lock, ABS, etc. It is obvious that today's Mechanical Engineer should have knowledge of many streams of engineering to sustain. And it is the same with the Engineers of other streams also. There is a need for modifying the curriculum according to above mentioned need. Research on multidisciplinary engineering projects and design is being done since past 30 years [1-5]. Also Nathan et-al [6] in his work has clearly indicated the significance of multidisciplinary engineering work. Efforts have also been made to design new courses which are multidisciplinary [7]. Department of Mechanical Engineering, BVBCET has also made a small effort in filling the above mentioned gap.

A. Traditional Workshop Practice Lab Course

Course Instructors at BVBCET chose Workshop Practice, a laboratory course for experimentation. Workshop practice lab is a course of mechanical engineering which is common to freshmen of every stream of engineering across Karnataka, India. This course is most suitable to make some innovations. The changes made will be reflected on every freshman. Traditional workshop practice lab curriculum consisted of experiments purely from Mechanical Engineering stream. Like Fitting exercise, Welding exercise, Sheet metal shop, etc. This course is the most suitable for students from Mechanical engineering stream. But however for other streams like Electrical or Electronics it is not very relevant since the curriculum will not be helpful for them in their future career. This is the reason the Laboratory course Workshop Practice is selected for experimentation.

II. ENGINEERING PRACTICES LAB COURSE

Traditional Workshop practice course is modified to make it multidisciplinary and named as Engineering Practice (EP) Lab. The curriculum structure and implementation of EP lab is discussed below in detail.

A. Objective of EP Lab

The EP lab is designed in a way that all aspects of engineering are covered. The student should work on Mechanical, Electrical and Electronics streams and also should understand the interdisciplinary nature of these three main streams of engineering in various day to day products which he comes across.

B. Implementation and Observation: Curriculum of EP Lab

Biggest challenge faced while implementing EP laboratory course was in making ready the course instructors, which involved training on electrical and electronics part, because the course is taught by Department of Mechanical Engineering. Though it is a hurdle, the results obtained thereafter are very good. Many course instructors at Department of Mechanical Engineering got updated themselves with newer knowledge. Below points indicate the different parts of curriculum of EP Lab.

1) Unit 1: Introduction to Workshop

This is the first unit of EP Lab curriculum. In this part the student is exposed to Mechanical Workshop. He will perform certain jobs using fitting, welding and sheet metal operations. He will also learn the use of different commonly used engineering tools. Student will also learn to follow code of conduct in workshop and to take care of safety precautions.

Student learns the use of engineering tools in an innovative way. A bicycle will be given to team of 3 or 4 students. They will dissemble all the parts of bicycle and assemble it back to working condition. Figure 1, 2 and 3 show the students working on Assembly and Disassembly of bicycle. An added advantage of this part in curriculum is student also learns the different parts of bicycle which he doesn't usually see by just riding it. Like balls and cone arrangement for bearing, freewheel, chain lock, etc. Level of understanding about bearings, freewheel and other components in bicycle and use of different engineering tools are increased from L1 to L3 [8] when compared to theory course. Below is the table indicating the interpretation of Bloom's levels according to David R. Krathwohl [8].

TABLE I. BLOOM'S LEVELS

	Bloom's Levels	
L1	Remember	Recognising, Recalling.
L2	Understand	Interpreting, Summarising, Exemplifying, Inferring, Comparing, Explaining.
L3	Apply	Executing, Implementing.
L4	Analyse	Differentiating, Organising, Attributing.
L5	Evaluate	Checking, Critiquing.
L6	Create	Generating, Planning, Producing.

Fig. 1. Students working on assembly and disassembly of bicycle.

Fig. 2. Students working on assembly and disassembly of bicycle.

Fig. 3. Different tools used by students.

2) Unit 2: Introduction to Electrical & Electronics

In this part of curriculum the student learns the basics of Electrical and Electronics streams of Engineering. As a part of Electrical stream simple two way wiring, tube light wiring and troubleshooting of simple electrical appliances are learnt.

Figure 4 and 5 show the students working on different experiments of electrical stream. This part of the EP lab helps the student to understand and use various electrical colour codes, fuse, switch etc. even in his day to day life.

As a part of Electronics stream the student learns the basics about various electronic components like resistance, diode, LED, breadboard, etc. Student practices a simple circuit of flashing LED using 555 timer IC on breadboard. Until Pre University education in Karnataka, India there is very few part of curriculum which involves breadboard and its use. Only few students who opt electronics as their elective course know the use of breadboard and any other electronic components [9]. However it is also true that without breadboard making any electronic circuit is very difficult. This part of EP lab is earnest approach for making undergraduates know about breadboard and other electronic components at the freshman level itself. Also it is important to notice that the student uses all the components hands on, which again increases the level of understanding about those components from L1 to L3 [8] when compared with theory course.

Fig. 4. Students creating a two way wiring circuit.

Fig. 5. Students working on Tube Light Wiring circuit.

3) Unit 3: Building Robots.

This is the part of EP lab where the second objective is fulfilled. The student will be able to understand the significance of multidisciplinary engineering. As a part of this unit Student will build a wire controlled robot. The wired robot should be built such that it performs a task of lifting and placing a box made up of rigid foam or any other object. Varieties of linkage options will be made available. A small amount of open ended nature is put in the problem statement, which makes the student to think at different level than usual.

Student also builds a programmed robot using a microcontroller. Here the student will be building a motor driving circuit which will be controlled by micro controller. This part of the unit makes student to work more on electronics using relays, transistors, diodes, etc. Again through this part of EP Lab, understanding about various aspects of electronics and mechanics are achieved at L3 level [8]. More importantly he will learn about the significance of multidisciplinary engineering. Since the student comes across the practical aspect of the merging of many engineering streams, he gets motivated in learning concepts of other engineering streams. Below are some pictures of students working on the abovementioned exercises.

Fig. 6. Students building a Wired Robot.

Fig. 7. Students building a Wired Robot.

Fig. 8. Students building a Programmed Robot.

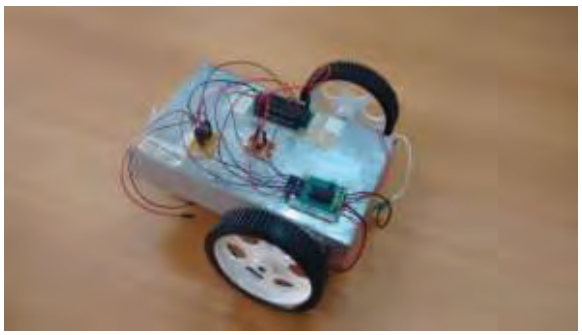

Fig. 9. A Programmed Robot built by students.

III. Conclusion

When compared with traditional Workshop Practice Laboratory course, EP Lab course is much more relevant to all engineering students irrespective of any stream. The student gets exposed to 3 main streams of engineering and also learns the necessity of multidisciplinary nature of engineering solutions. Through which criteria d of student outcomes can be achieved which was not possible through traditional Workshop Practice course [10].

In traditional workshop, student understanding about various Mechanical aspects happen at a level of L3. But there is no scope for other streams. In EP Lab the understanding about Mechanical stream is maintained at L3 and also the level of understanding about various electrical and electronic components can be increased from L1 to L3 at the freshman level itself [8]. This also gives an opportunity of student working for multidisciplinary projects immediately from second year of engineering.

The student having more practical knowledge about various streams of engineering can be more effective team member in multidisciplinary projects as he can understand and communicate better. This way EP Lab curriculum also aids criteria g of student outcomes to a small extent [10]. The other criteria which can be satisfied by EP Lab curriculum are a and b [10].

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