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Cut-Section Modules to Enhance the learning of Automotive Electronic Course

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Abstract: Automotive industry has grown significantly in the recent years and the expectations from an undergraduate are peaking up day by day. The automotive industry giants like Robert Bosch, KPIT, Mercedes Benz want industry ready graduates to put them on the project directly without spending much time on the OJTs(on job trainings). This would greatly reduce the time to market their products. The automotive industry is looking for the skilled engineers having strong knowledge of Automotive Systems along with electronics background.

To address the industry needs stated above, at a institute level every student undergo automotive electronics theory course as a part of the curriculum during sixth semester but this does not completely fills the gap because students of electrical stream students have very little knowledge of automotive subsystem except very few basic parts but if students of electrical science has to apply electronics or build any system, they should have thorough knowledge of mechanical parts of the automotive systems. In order to fulfil this gap students are exposed to cut section modules in the automotive electronics lab and this exposure definitely helped the students in understanding and enhances the learning of the automotive electronics course.This indirectly boosted the placement count.

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1. Introduction

The automotive industry is growing rapidly and will continue to do so in the future. The reason for this rapid growth is due to the demands from various entities such a customer needs, government norms and regulations, keep pace with competitors. The best example is the new emission testing cycle, the European testing procedure NEDC has been replaced with WLTP(worldwide harmonized light vehicle test procedure). This means modern vehicle technology can be accounted for. This call for the new functionality to be introduced in a vehicle to monitor emission and every new application would require significant contribution from the field of electronics and related software.

Every OEM (Original Equipment Manufacturer) such as TATA, Hyundai, Honda etc and Tier-I such as BOSCH, DELPHI and CONTINENTAL always wants to reduce the time to market their product by reducing development and testing time to be in the race. If OEM and Tier-I have to reduce the development and testing time they should have skilled employees with rich set of experience. Another very important aspect to be considered here is that,

automotive industry is purely multi disciplinary in nature that means it does not belong to just mechanical domain. Industry requires people across different domains such as electrical, mechanical, automobile and computer science, information science and as well as architecture department. Most importantly software and electronics has a bigger share in modern vehicles. 35-40% of the vehicle cost due to the electronics and software that goes into the vehicle. Today modern vehicles have about 70 ECUs (Electronics Control Unit) spanning across different domains of automotive such as power train, chassis, infotainment and Body control domain.Each of these automotive domains has huge man force working to build a electronics system to control/monitor/replace the mechanical component and 90% of these engineer are all from the electrical science background who must know all the mechanical components related to their electronics domain, for example, power train control unit engineer must know about the complete drive line knowledge right from engine to transmitting torque to the wheels.

This is the main reason to introduce the cut-section modules of automotive into the Automotive Electronics laboratory for the third year students of electrical, electronics and instrumentation at sixth semester level with help of industry collaborations. The industry institute collaboration helped in framing the set of experiments and demonstration session on the automotive cut section modules.

The Institute and Industry engagement has taken different forms at different times. Earlier, it started with simple interaction and gradually evolved to very close partnership overtime. The gap between regular theory course taught and industry requirement for employment was huge. Somebody had to break the ice to bridge[10]. Our institute made serious efforts to make the engagement and collaboration happen. We need to build an implicative system to bridge the skill gap and to sustain in the changing scenario; [1][6].

This paper puts out the success story of how institute and Industry collaborations helped to fulfil the gap and through the engagement made us to introduce the cut-section modules. Here paper focuses on core recruiters in automotive like Robert Bosch, KPIT, Mercedes Benz, Continental and Delphi. The paper discusses about the different modules that are included in the automotive electronics laboratory.The modules include various latest technologies, domains of automotive mechanical sub systems,electrical and electronics systems at different levels. Providing practical exposure of the automotive modules at the under graduate level and step up to the higher level of competency in this field automotive is the goal of this initiative. Industry also helped the institute by conducting the Faculty development Program at industry as well as at the institute. This helped the institute to understand and identify the needs and requirement of the industry.

Organization of the paper is as follows, section 2 deals with Establishment of industry-institute engagement, section 3 deals with cut section modules section 4 deals with Impact of the initiative to include cut-section modules of automotive subsystems and section 5 with conclusion.

2. Institute- Industry Collaborative Engagements

Institute and industry collaboration played a vital role in setting up of the automotive electronics laboratory including the cut-section modules. Lot many inputs received from our major partners such as BOSCH and KPIT as depicted in the Fig.1. Based on the input received, cut-sections modules have been included as part of curriculum. The actual reasons to consider the inputs on cut sectioned demo modules is the survey report indicating that very large number of the Indian Engineering students not fit for employment immediately after their graduation and this has been expressed by the many Indian and MNCs. Fresh graduates lack in skills required by the industry. The typical automotive industries spend about six months to a year to train the fresh graduates on the latest technologies of automotive to put them on the job and develop specific skills. There is always a requirement of qualified employees and, always industry try to reduce the on job trainings. The collaborations between both would bring both the entities closer to create synergies [2]. The collaboration sums upthe strengths of institute and industry, former is good at the theoretical teaching and later is at the practical exposure.

The automotive industry is one of the leading economies in the world. The contribution from group of automotive industry with 80 millionvehicles every year, becomes the important revenues generating entity for government all around the world [3][7]. The automotive industry is composed of engineers across the multiple domains and is multidisciplinary in nature. The automotive industry requires people from Embedded domain, image processing domain,

mechanical domain, architectural and so on. The work force right from requirements to vehicle release to the market creates huge job opportunities globally [8][9].

The KLE technological university formally known as BVB College of engineering and technology collaborated with the Robert Bosch Engineering & Business Solutions, India and KPIT info systems, the two main leading automotive industries.

Memorandum of Understanding (MOU)s was signed between the above mentioned industries to initiate the industry-institute engagement as depicted in Fig. 1. The mode of working is just like a

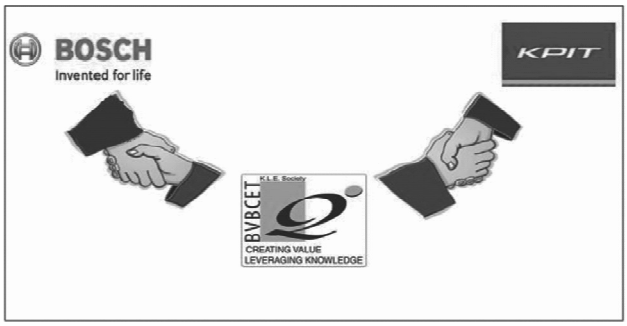


Fig 1. BVB and Automotive Industry Collaboration

AUTOSAR slogan "cooperate on standards and compete on implementation" , though Robert Bosch Engineering & Business Solutions, India and KPIT info systems industries are competitors but they are collaborators to us. The industry collaboration objectives are to,

- Co-design of the syllabus
- Train the trainer.
- Creating internship opportunities for students.
- Step-up no of placements
- Strengthen practical skills of both faculty and students
- Bringing up the competency level of the faculty & student with advanced automotive technologies

3. Cut-Section Modules of Automotive sub-systems

The modules covered in automotive electronic laboratory areas follow,

A. Cut-Section Model of Chassis Working.

B. Cut Section Model of Power Windows.

C. Cut Section Model of Mock Layout of A Maruti Car Wiring.

D. Cut Section Model of Steering system.

A. Cut-Section Model of Chassis Working

The cut-section model as shown in the Fig.2 is made out of original vehicle. Every component is clearly visible right from the ignition to the wheels. The major automotive systems that students focus are Engine, transmission unit, fuel system, exhaust system, suspension, braking and steering and electrical system.

1. Engine

Model consists of four strokes MPFI (multi point fuel injection) petrol engine but it is driven by 230V ac single phase motor. Students can visibly see the four different strokes taking place. The cut section of the

Fig 2. Cut-Section Model of Chassis

engine is fitted such that all the engine components can be demonstrated in live working condition.The cut sectioned engine consists of inlet valve, outlet valve, inlet manifold, outlet manifold, alternator, piston, cylinder head, sensors, ECU, common rail, starter motor, throttle etc., all of these components are sectioned to demonstrate the working easily.

2. Transmission system

The Transmission system consists of a cut-section of clutch and gearbox assembly, the casing helps to demonstrate the working to the students.The setup also includes hydraulic circuit for brake and clutch,helps to demonstrate the response of hydraulic

systems. It also includes differential gear box with an axleand the different coupling used for the transmission of torque to the wheels. The cut section of the differential gear box demonstrates its complete operating principle.

3. Fuel system

The fuel tank is cut to demonstrate the sensor mounting to detect the fuel level and the position of fuel section. The mounting of the fuel pump inside the tank demonstrate how fuel is circulated from tank to the injection system.

4. Exhaust system

It consists of exhaust manifold and silencer in cut section to explain internal construction and path of the exhaust flow. Demonstrate the use of catalytic converter and silencer.

5. Lubrication system

It consists of the engine lubrication system along with the lubrication oil pump.

6. Suspension system

The module demonstratesboth the leaf spring suspension at the rear and the hydraulic suspension systems at the front. During the demonstration students are advised to give thought on electronics can be applied to the system so as improve the performance or control or replace certain components for improving the efficiency. The cut-section shown in the fig. has steering wheel, steering arm, and the steering axle with rack and pinion arrangement.

7. Braking system

The module in-house the cut section of hydraulic brake circuit.The hydraulic braking mechanism activates movement of the brake shoes against wheels on depressing brake pedal. The module is equipped with both drum brake and disc brake.

8. Electrical system

The electrical system demonstrates the overall idea of the electrical system across the vehicle. The system includes the cut section of the battery and terminals many more accessories such as a cut-sectioned self starter, dynamo, wiper motor, cutout, distributor, horn relay, etc. , and working of head light brake light, side indicator, horn, parking lights, spark in spark plugs, etc.

B. Cut Section Model of Power Windows

The model shown in Fig.3is made out of original used parts, suitably cut-sectioned to demonstrate& show the minute information of the power windows such as motor and its gear arrangement and working of the same can be shown by connecting it to a battery.

C. Cut Section Model Of Mock Layout Of A Maruti Car Wiring

The demonstration board displayed in the Fig.4

Fig.3 Cut Section Model of Power Windows

showcase the mock layout of Maruti Car wiring. The board gives the fair idea about the electrical system of a Maruti Car. The demonstration board provides a flexibility for the students operate and verify the working of individual parts such as self starter, side indicators, sparks of spark plugs, alternator, horn, brake light, head lights, tail lamps, parking lamps, distributor, wiper motor, etc. ,. Some parts of module are sectioned to show the internal constructional details.

D. Cut Section Model of Steering System

The cut-section model of the steering system shown in the Fig.5 is made from the original vehicle steering. The model shown is sectioned suitable to demonstrate the working of steering system, and students can easily correlate the theory part with system shown. The system is mounted on the solid

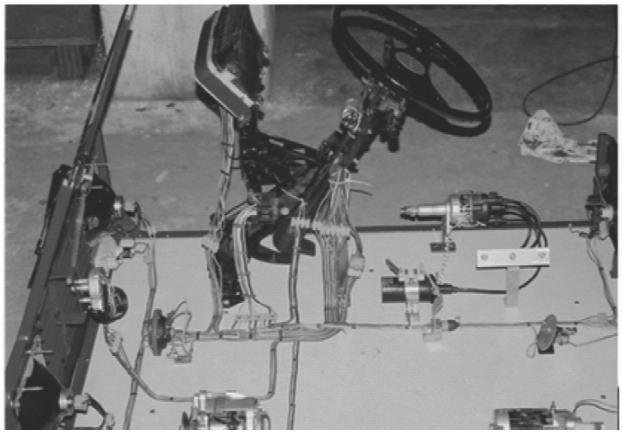


Fig.4 Cut Section Model of a Maruti Car Wiring

frame so that students' can practical operate the steering and observe the steering movement. During the demonstration students are advised to give thought on electronics can be applied to the system so as improve the performance or control or replace certain components for improving the efficiency.The cut-section shown in the fig. has steering wheel, steering arm, and the steering axle with rack and pinion arrangement.

4. Impact of including cut-section modules of automotive subsystems

The cut section modules included in the

Fig.5 Cut Section Model of Steering System

automotive electronics laboratory effectively bridges the gap between industry and institute. This would be the ideal win-win model for KPIT, BOSCH and BVBCET collaboration[4].It is basically considered to improve the quality of graduates and vocational education adequately to meet the needs of the industry and economy. Some of the benefits derived from this initiative are,

A. Benefits for Iinstitutes

1) Enhancement in student placements:

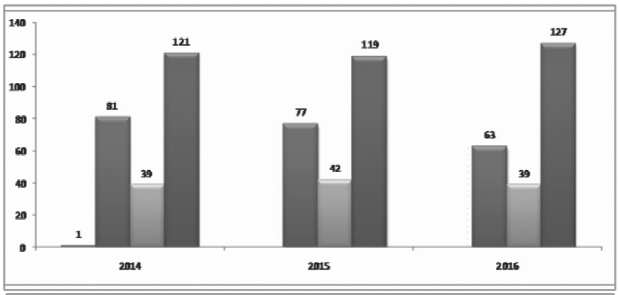
The major benefit of including the cut-section modules was, increase in the number of student placement in automotive industries because of the thorough knowledge of automotive sub-systems along with electronics. There was a substantial increase in automotive companies visiting our campus. The collaborated companies viz. KPIT and RBEI have increased their intake of the number of students. KPIT visited our campus three times for recruitment of the same batch of students i.e. during 2013. The Fig.6 shows the continuous improvement of placements of our students in automotive industries for the past three years.

2) Internship to students:

The collaboration also resulted in creating internship opportunities for the students. Both KPIT and BOSCH are providing the internship for undergraduate and post graduate students. The opportunity provided to the students helps the students to explore and learn latest technologies and correlate with cut-section modules available in the laboratory[5].

3) Enhancement in students' performance in reassessment test:

KPIT conducts reassessment test on automotive electronics and AUTOSAR subjects. The reassessment test is conducted for the recruited students after completion of the graduation. It's been observed that after the inclusion of the cut-section



Particulars	2014-2015	2015-2016	2016-2017
Registered (Placed)	150 (121)	143 (119)	146 (127)
Core (Automotive @ KPIT, Benz, BOSCH, Continental)	81 (63)	77 (43)	63 (59)
IT	39	42	64

Fig 6.Placement Statistics

modules in the lab, students understanding of the course has been increasingly better which is reflected in their reassessment test.

B. Benefitsfor Industries

1) Industry gets qualified employees:

Recruiting new team members who are already exposed to latest automotive technologies can cut down OJTs (On job trainings) considerably and makes them available on board as early as possible and becomes billable and can generate huge revenues. Since new team member is already on board development work can take faster pace. Projects deadline can be met well within time. This makes industries grow stronger and faster and take up new challenges and compete with global challenges.

2)Reduction in R&D cost of industry:

The collaboration and initiative makes graduates learn underlying technologies well before joining the industry and provides a strong platform for industry based research and product development.

5. Conclusion

Exposing students to cut section modules as detailed in the paper enhances the learning and understanding of the automotive electronics theory course and indirectly helped industry-institute engagement there-by increasing placements. As per the feedback received by the core recruiterKPIT for the institute, there is reduction in the on job trainings. The performance of our students at the reassessment test and test conducted at industry very high as compared with other institute. OJTs have been reduced by 32% and four months reduction in training period. This is a ideal model for both BVB and KPIT and makes win-win situation. This indirectly made BOSCH, Continental and Delphi to visit our campus for recruitment and collaboration.

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