

AC 2007-723: USE OF AN AUTOMOTIVE TECHNOLOGY COURSE IN ENGINEERING TECHNOLOGY

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Abstract

The automobile has been a source of engineering discoveries and employment for the last century. Many different disciplines go into the manufacturing and design of the automobile. The principles of the different engineering technology disciplines can be shown through the use of a general automotive technology course.

At the University of Dayton the graduates of the engineering technology program have a good chance of interviewing and possibly even taking a job in the automotive field. It was felt that the students would benefit from taking a course in basic automotive engineering to allow them to have knowledge of these principles before interviewing for a position in one of these companies. This course would introduce them to basic systems, components, and terminology as it applies to many engineering technology disciplines. Also the business aspect would be developed as well as how government regulations influence automotive design. This paper will describe the process of developing this class as well as some of the details and how it relates to a multi-disciplinary engineering technology program.

Introduction

Alan Greenspan in September of 2000 talked about the skills needed in automotive jobs. This emphasized the importance of the automotive industry in the United States.¹ Mercedes-Benz has invested money into automotive education at the high school level.² Tennessee is investing

on a state level a large amount of money in developing automotive companies and suppliers as well as a well trained workforce.³ Automotive technology is important to the United States economy.

Being in the Midwest the University of Dayton is located very close to many companies that deal with the automotive market. In engineering technology it looked like a natural fit to incorporate a course in basic automotive technology. The purpose of the course would be to expose students to basic automotive systems and how the individual parts operate. This would allow the students to be able to interview more intelligently in the automotive markets and also take a class in an area that many students are interested in. Being a program that emphasizes real experience and also application based education an elective in automotive technology seemed like a natural fit. Dayton, Ohio has been a community in which the automotive market has been the major employer. Many companies in the automotive industry are located either in Dayton or within a couple of hours perimeter. These companies hire these graduates and expect them to have a basic level of knowledge of their industry.

Goals of the Course

Developing the idea the faculty came up with many options on how the course should be taught. The idea was to not develop a course to teach students how to repair cars or to become technicians. The goal was to allow students to have a good knowledge of how automobiles operate in order to be able to interview in the automotive market. Also the course was to be developed with many other courses in mind to show the students how these courses link with

some practical applications. It was to be a three credit hour elective so some decisions had to be made on what can be taught and what would have to be left out of the class.

There were five different fields of study considered, Mechanical Engineering Technology, Industrial Engineering Technology, Manufacturing Engineering Technology, Electronic Engineering Technology, and Computer Engineering Technology. A class would have to be developed with all these majors in mind. The basic engineering skills of statics, dynamics, economics, materials, processes, and circuits would be incorporated.

Automotive employers, alumni and current faculty were consulted. The idea for a course in automotive technology was presented to the industrial advisory board of the engineering technology department. It was decided after much deliberation that a course would be offered and what would be included in that course.

Structure of the Course

The course was developed as a three credit hour elective. Some lecture, some hands on experiences, and some tours were planned. The class had 27 students that enrolled in the first semester it was offered and 33 in the second semester. One difficulty was what topics to teach. Another difficulty was how to incorporate some hands on experiences with this many students. Another was what kind of textbook to use. The knowledge level of the students that would be taking this course had to be considered. What the evaluation techniques would be had to be detailed. The final difficulty was what tours to take that would enhance the learning experiences of the students.

It would not be feasible to teach every system and every component on the automobile. After much discussion and research it was decided that the following would be taught. The history of the automobile was very important in discussing how the components worked today as well as the economic and business aspect of the automobile industry. Also how the automobile affects the economy today and how business is conducted was felt to be very important. Government regulations and how they affected design was deemed to be very important. Finally the engine, chassis, powertrain, and electrical systems were the systems chosen to be covered. Table 1 lists the topics that were taught in this class.

The University of Dayton does not have an automotive lab. For this class automotive components were brought into the classroom for demonstrations. Also many different pictures and diagrams of parts and systems were obtained to be shown.

The textbook that was decided upon was Automotive Technology a Systems Approach by Jack Erjavec. Much research was completed in finding a book that was not into repair as much as describing how the components and systems worked. This book had a lot of good descriptions on operations as well as some science behind why the components worked the way they did.

Table 1 - Automotive Topics

• History of the automobile
• Engine Systems
○ Measures of performance
○ Engine chemistry
○ Combustion cycle
○ Engine types and configurations
○ Engine components' design
▪ Cylinder head
▪ Valves
▪ Camshaft
▪ Block
▪ Crankshaft
▪ Connecting rod
▪ Bearings
▪ Piston
▪ Oil pan and lubrication system
▪ Cooling system
▪ Gaskets and seals
▪ Intake and exhaust systems
▪ Fuel system and injection system
• Fuels
• Powertrain
○ Clutches
○ Manual transmission
○ Automatic transmission
○ Torque converters
○ Drive systems
• Chassis
○ Brake systems
▪ Drum
▪ Disc
▪ Anti-lock braking systems
○ Suspension systems
○ Tire design
• Electrical
○ Batteries
○ Charging systems
○ Ignition systems
○ Computer systems
• Alternative fuels
• Manufacturing
• Supply chain

Major consideration had to be given to the knowledge level of the students taking the course. Students at the University of Dayton had experience levels ranging from no automotive experience to some who worked as a coop in an automotive environment to some who do their own automotive work as a hobby. What was interesting was that in the second semester the course was offered to 12 students from Shanghai who not only had very little exposure to automobiles, they did not even have a driver's license. It was decided to try to reach all these levels. All sections had a basic introductory level for the first few minutes to more advanced information later in class. Many outside readings were given to add to the student's experiences and to allow them to learn some information on their own and at their own pace. Students were encouraged to ask questions and also to participate in discussions to teach other students what they know.

Evaluation would be difficult. There had to be a system in place to evaluate how each of the students was doing in the class. Two in class tests, one take home test, some position and research papers, and a final project in an emerging technology in the automotive industry was chosen. Table 2 shows how the class was evaluated.

Table 2 - Evaluation Criteria

Assignments	Breakdown
Test #1	15%
Test #2	15%
Test #3	15%
Homework & Participation	20%
Final project	10%
Final Exam – Comprehensive	25%
Total	100%

Course Delivery

The topics in the course were to be delivered in a way that would be understood by students with no previous knowledge of automotive systems and also interesting to students who have a lot of experience. The basic science was presented first. This included mathematics and basic science needed to understand why the system would work. One example is using Paschal's equation before introducing hydraulic brake systems. Then the basic components were looked at. The system was described as a combination of these components. Finally advanced systems were analyzed and what future systems would look like to allow students to see the possibilities in this industry.

There were a couple of projects completed by the students in this class. Research was completed on alternative fuels and a position paper on the different types of alternative fuels was written on where the students felt industry and the government would go. A position paper was written on what the students thought made an automobile exciting. Different engine types and manufacturers were researched and presented. A detailed discussion on the automotive market in various parts of the world was performed. This entailed who are the leading companies, who have a share in which companies, what types of vehicles do they manufacture, and how much do they sell.

Many diagrams of component function were shown. Also pictures of the components from various manufacturers and where they were located in vehicles were also shown. The system level was first presented. What was the purpose of each system and how did the system operate

was presented. An insight into the design process was looked at. Then the component level was presented, using various manufacturers and why they used the various parts.

There were many courses that were used as reference to this course. In looking at engine design basic thermodynamics and heat transfer was used. Also chemistry in discussing fuels and oil as well as corrosion was used. Vibrations were looked at in a basic way discussing chassis systems. Fluid dynamics was used in brake systems to describe how they are designed and function. Various forces in every system were linked to statics and dynamics as well as strength of materials. Digital logic and circuits were used in the ignition and charging system as well as describing how all the sensors worked. Finally manufacturing processes were used in discussing how all of the components were produced.

Results

Class evaluations were taken after this class. Table 3 shows the results of the student evaluations in 2 key areas. A scale of 0-4 was used with 4 being strongly agreed with the statement.

Table 3 - Student Survey Results

Question	Score Semester 1	Score Semester 2
	90% responded	87% Responded
I learned a great deal from this course	3.2	3.3
I would recommend this course to other students	3.4	3.4

The following are some of the comments from students about the course:

- All elements of the course increased my knowledge because I was not familiar with the systems of automobiles
- I went into the class knowing a lot, but still learned a great deal about things I didn't know before
- Researching and writing papers helped me to understand some material better
- Overall very good class and well taught, very worthwhile and interesting class
- Would be very interested in future automotive classes
- I thought the knowledge level was good. It was challenging enough for someone who knew nothing about cars but not so incomprehensible that I couldn't understand it

There were a couple of problems with the course. Two of the tours that were supposed to happen did not come about due to some problems with those companies. The only tour that actually happened was a tour of a dealership. This tour showed the students the business aspect of the automotive industry. More computer models were needed to show vehicle dynamics. More activities that allowed the students to perform activities with the parts would have been better.

Conclusion

The class developed in automotive engineering technology at the University of Dayton has been a success. It has contributed to the knowledge level of the students who have taken it by giving them information that is useful for them in employment in an automotive environment. These will include adding more tours, looking at more computer modeling, having more activities for the students to actually perform on parts, and possibly having a vehicle in which to remove parts

and see their functions. Overall the students thought the course was very beneficial and the administration felt it was worthy of offering as a regular elective.

Bibliography

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