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A Study and Evaluation of the Automotive Program at the Utah State Agricultural College

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A STUDY AND EVALUATION OF THE AUTOMOTIVE PROGRAM AT THE UTAH STATE AGRICULTURAL COLLEGE

by

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INTRODUCTION

Introductory statement

As the graduates of colleges and universities receive their diplomas and leave their Alma Mater, a new and different challenge confronts them. Their problem now is not one of being free of the struggles of completing their education but rather the anticipation of what will be their success in the future. They feel that now they are qualified to take over new jobs and responsibilities for which they have been trained. Many will be successful in securing good positions in their respective fields (others may have to start at the bottom and gain their advancement through more learning while on the job).

Many of these graduates will secure employment in fields entirely foreign to those for which they feel they are well qualified. To their minds will no doubt come the question, "What good has my college training been to me?" The answer to that question could lie in the subjects of the curriculum they folloed in college. They have followed a prescribed course which contains subjects designed to give them a well-rounded education. Some have followed the course faithfully while others have deviated slightly. This deviation may prove harmful in some respects and beneficial in others.

Because of the fact that many students do have difficulty in obtaining employment, they place the blame on the subjects in the curriculum as well as on the advice given to them by their class

advisers. Many students attempt to have classes waived if they have trouble with them. Some students feel that they are better qualified than they really are, and as a result are discouraged when opportunities arise and they are incapable of handling the work given to them.

Finding a means to determine student qualification is the purpose for which this study was made.

It is the intention of the author to attempt to solve some of these problems in order that future students in the Automotive Department at the Utah State Agricultural College might be better qualified to meet the occupational demands of the automotive industry.

Statement of purpose and method of procedure

The purpose of this study is to determine the value of the automotive training program at the Utah State Agricultural College in terms of its contribution to student success after graduation and its value to the automotive industry. The author also wishes to compare this program with those of other schools offering courses in the automotive field, including vocational schools as well as those teaching mechanical engineering.

The questionnaire method was used for this study because information had to be received from many areas of the United States. Some personal interviews and letters were also found to be valuable in obtaining additional information and opinions.

A study was made of the available literature on the subject of personnel qualifications in the automotive industry, with a particular reference to the increasing demands for greater technical training for those entering the industry.

It is generally recognized that training should be based on current and anticipated needs of enrollees. It should also be based on placement information of graduates, if training is to be kept up-to-date. Since a study of this type has not been made and information of this nature is desirable to improve the program, a need of this study seems apparent.

By sending out questionnaires to students who have graduated from the training program during the years 1950 to 1954, and by sending similar questionnaires to industries that are concerned with the manufacturing of automobiles and parts, and to schools that teach automotive subjects, a comparative study will be made to determine how adequately the program meets the demands of its graduates and the industry itself.

A total of 150 questionnaires were sent to the above mentioned students, schools, and industries. A letter and a copy of the present curriculum were enclosed with each questionnaire. A copy of the questionnaire and the accompanying letter are to be found in the appendix. There was a 51 per cent overall return on the questionnaires. Since some of the questions were unanswered, it was necessary to compute percentages on the basis of the particular item in question.

Questions for study

Questions involved with the placement phase of the study are:

1. What general types of employment do graduates enter upon graduation?
2. Are the jobs students accept after graduation in line with their training?
3. What factors influence the type of employment students accept?

4. What trends can be identified which relate to placement?

5. What additional placement opportunities have resulted during the four-year period?

Questions related to the training phase are:

1. Are the classes completed by the student sufficient for his present position?

2. Are there classes in the curriculum that are totally unnecessary?

3. Are there classes in the curriculum that should be strengthened?

4. Is the training program as up-to-date as it should be?

5. Should more classes be given which are related to specialized fields?

6. Would additional and more extensive classes improve the training program?

Issues involved in the study

Some issues involved in the study are as follows:

1. What changes are needed in the present curriculum?

2. Is there a need for the two-year training program on the college level?

3. Is the college obligated to place its graduates?

ANALYSIS OF THE PRESENT PROBLEM

Course curriculum

The classes offered in the curriculum of the automotive training program are designed to afford a well-rounded education to the students who complete all the classes that are listed. Classes are so outlined that they meet the requirements set forth by the college for a bachelor of science degree (12, p. 56)*

It is highly recommended that students attempt to meet the maximum of 202 credit hours as it is felt that they will be better qualified to meet the demands of industry.

General make-up

The curriculum is outlined in such a way that students from other departments on the campus may take classes that will help furnish information about the automobile. There are seven service courses in the curriculum which are suggested for such students. The courses are:

Auto 51, The Automobile Chassis, which offers the principles and practices in construction, operation, and servicing of the modern automobile chassis. Units of this class include the axle, wheel suspension units (all types), steering gear units, auto frames, springs, universals, drive shafts and brakes.

Auto 52, Automobile and Farm Power Plants, which includes principles and practices in the construction, operation, and servicing of the modern

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* Refers to numbered entries in the bibliography.

automobile and farm power plants. Units of this class include cylinder block assemblies, piston assemblies, crankshaft assemblies, valve assemblies, clutches, transmissions, overdrives, fuel systems, cooling and lubrication systems. The Otto cycle in both two and four-stroke as well as the diesel cycle are considered in this course.

Because of the great number of automobiles in operation today and the desire of every young boy and girl to own and operate one, this class is the one most in demand.

Auto 53, Automobile and Farm Engine Electricity, is a course in principles and practice in the construction, operation, and servicing of electrical systems used in modern automobile and farm engines. Units studied include starting, generating, lighting, ignition, and special accessory systems.

It will be noted that some of these courses which are open to any college student are also listed in the regular curriculum for those students majoring in auto body reconditioning and diesel technology.

Auto 54, Service Techniques, is a class based on the theory and practice in service station and shop management, with emphasis placed on professional ethics, record keeping, selling and installing automobile accessories, making minor repairs, and lubrication. This course was added to the curriculum of the automotive major to help fill the gap between the major courses.

Auto 61, Body and Fender Repair, covers the principles and practice in the fundamentals of fender and body repairing, including work in metal finishing, light welding, door and body allignment.

Auto 62, Upholstering, includes the principles and practice in repair of modern upholstery. It includes rebuilding and recovering of automobile upholstery and home furniture. There is a great demand for this class by non-automotive majors. This is especially true of those students majoring in Industrial Education.

Auto 162, Metal Refinishing, includes a study of the principles and practice in preparing metal for refinishing, the fundamental procedures in priming, surfacing, and applying lacquer, enamel and other special finishes. The refinishing of wood surfaces is also emphasized in this course. The course is particularly beneficial for those students who are majoring in the Industrial Arts program.

These courses are listed as part of the regular curriculum (see Appendix), but mention is made of them here for the purpose of emphasizing the courses which are offered by the department for those students who are not majoring in automotive training.

A Certificate of Completion is also offered to students who satisfactorily complete the courses offered in the freshman and sophomore years of Automotive, Body and Fender Repair, and Diesel Technology. Students who complete this program receive certificates entitling them to work in automotive shops as apprentices.

The automotive classes in the 1950 schedule bulletin made a revision separating the lecture period from the laboratory period, giving each class five hours of credit. These major classes met five days a week, with a one-hour lecture followed by a three-hour lab. This made a total of five hours of lecture and fifteen hours of lab time each

week. The lecture period and the lab period were each given separate numbers, which made it necessary to give a separate lecture and lab grade. This arrangement worked out well for those students who were working for a Certificate of Completion. For the student majoring in automotive technology it presented a problem, because half of each day was taken up with automotive classes. As a result the four-year student had difficulty in acquiring the necessary number of upper division credits.

Frequently, students who find the work in the regular four-year program too difficult change to the easier course leading to the Certificate of Completion. On the other hand, many students who begin the two-year course find automotive work much to their liking, so they change to the regular four-year course leading to the bachelor's degree.

The present curriculum shows some changes in the major classes and also shows some additional classes which were not in the 1950 schedule.

ED 93, Mechanical Drawing, was added to the two classes already offered in engineering drawing in order to give the student more development in drafting. The two drawing classes that were required were not sufficient, however, to meet the demands of industrial draftsmen. The additional course included basic work in industrial drawing and the techniques of architectural, structural, and electrical drawings.

Auto 1, Steering Correction; Auto 2, Automotive Engines; and Auto 3, Driving Mechanisms, and the lab periods of each of these classes were changed from ten credit-hour classes to six credit-hour

classes. The time for these classes was changed from five days per week to three days per week.

Auto 101, Frame Suspension and Steering Systems; Auto 102, Internal Combustion Engines; and Auto 103, Automatic Transmissions, were added to the curriculum as follow-up classes for Auto 1, 2, and 3. These employed more advanced study of the subjects offered in Auto 1, 2 and 3.

The class numbers above 100 are classified as upper-division courses; therefore, the student was able to get more upper-division classes, which helped him considerably in total credit hours needed for graduation.

Aero 131, Time and Motion Study, was added to the course to give the student the opportunity to become acquainted with the techniques of time and motion and their inter-relationships. This class is very important to the student who considers going into an industrial field where precision is a major consideration.

AE 82, Forge Practice, was added to the course to teach the student, the fundamental operations of forging. This class gives the student the opportunity to learn how heating and hammering affects the structure of metals. The student learns how to construct tools and structural parts, and how to strengthen them through the many tempering processes that are employed.

Chem 125, Applied Organic Chemistry, was added in 1952 to give the student more background in the biological applications of organic chemistry. Emphasis in this class was put on the study of hydrocarbons, their derivatives, and the chemistry of carbon compounds and

the part they play in fuels and lubricants.

(A copy of the curriculum, with an explanation of these subjects listed, will be found in the Appendix).

Changing the course thus far has increased the number of upper-division credits from 51 to 71, which proved to be very desirable, for it gave the student the opportunity to fit in the extra classes of subjects related to the course.

Objectives of the automotive program

The automotive training program at Utah State Agricultural College offers a bachelor of science degree in Industrial Technology with Majors in Automotive Technology, Auto Body Reconditioning, or Diesel Technology.

The major aim of the Automotive Department is to prepare the student to become a technician in the Automotive Industry, a shop foreman or supervisor. It is intended to give the student an excellent background for entrance into civil service, private business, and key positions in industry. With some special preparation the student may qualify as an automotive instructor in high schools.

Students wishing to prepare themselves for advanced or graduate study at other institutions in automotive, diesel or closely allied branches of engineering are in a position to do so by substituting mathematics and engineering courses during their junior and senior years. This procedure is highly recommended.

The automotive program has been designed not only to give technical information to students, but to teach them principles of cooperation, personal ethics, and original and creative thinking. The program is in

line with the fundamental college policy; that is, it considers the main function of education to be the preservation and improvement of a democratic way of life. The objective of the Federal Land Grant Act of 1862 is a guiding principle; namely, "... to teach such branches of learning as are related to Agriculture and the Mechanic Arts, in such a manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life" (12, p. 41).

Facilities available for instruction

Training facilities at the Utah State Agricultural College include a new building designed and built specifically for automotive instruction. The building is located to the east of the campus; is easily accessible, and beautifully landscaped. The automotive and aircraft departments are located in this building. Each section has two classrooms which are large enough to accommodate 60 students each. The rooms are well lighted, ventilated, and equipped with the latest instructional aids that can be procured.

Some of the instructional aids which are used include such items as cut-away models of automobile parts and charts and diagrams secured from automobile manufacturers.

The classrooms are equipped with double doors so that the automobile itself can be brought into the room for instructional purposes. One classroom is equipped with the types of sewing machines and tools necessary for upholstery work.

The laboratories contain the most modern servicing and testing equipment, and training is conducted on a project basis on automobiles

that are in actual use. The laboratories consist of two large working areas which are divided to accommodate the various classes. A tool room is located between the two working areas so that it is easily accessible to all students.

The department follows the provisions of a code limiting student work to automobiles owned by the students, their parents, the college, and people on relief.

Equipment used for instruction in the laboratories includes such items as: a twin post hydraulic lift, which is a hydraulicly operated unit controlled by electricity; frame straightening and front end aligning machine complete with instruments, which gives the student a better understanding of steering geometry and the means of correcting necessary misalignment conditions; two-types of wheel balancers, to enable the student to learn to balance tires and wheels both on and off the automobile; brake drum lathes and brake relining machines; generator test benches, electrical testing and tune-up equipment, which enables the students to completely analyze the electrical system of the automobile (analyzed separately or checked while the engine is operating); an engine dynomometer, installed in a room designed for the purpose of having the student analyze the function of the internal combustion engine through the use of special instruments to show what takes place inside the engine; and a chassis dynomometer, used for the complete vehicle analysis while the machine is being operated under various comparable road conditions.

There is a working area which includes special equipment such as: piston lathe, clutch rebuilding machine, connecting rod aligning

machine, valve spring testers, valve grinding machines, diesel injection test stands, drill presses and hydraulic presses. This area is utilized by all automotive students, depending on the particular classes being taught.

The building is equipped with a spray painting room and a room for steam-cleaning the automobiles that are being used for instructional purposes.

The department has a staff of four instructors who are especially trained in their particular fields of instruction.

Two of the four instructors have bachelor of science degrees; one has a master's degree; one is at the present time without a bachelor's degree, but has had many years of experience in his field and is completing requirements for a degree.

TRENDS IN TRAINING NEEDS AND DEMANDS OF INDUSTRY

Trends in amount of training

Through the products of the labor of their own hands and minds, self-respecting men and women wish to give full return for all they receive and consume of the products of the labor of the hands and minds of others. They wish to pay their way fully and contribute something, the more the better, to the common wealth, to the sum total of material, intellectual, and spiritual accomplishments slowly accumulating through the ages.

There is joy in producing. One likes to create and transform. He likes to feel his power over the forces of nature, to combine and direct them. He rejoices in doing useful things skillfully and well, and in the feeling of independence and power these skills give him.

The world of the infinitely small is no less wonderful than the infinitely large, but everyone can learn enough to begin to understand the wonderful miracles of common things. By cooperation and pooling of knowledge one gains willingness to produce, transport, and otherwise serve so long as he controls that which he learns intelligently. Most of our modern industries are built on such knowledge.

Students of today do not have such opportunities as children once had to learn at home and from parents, older brothers and sisters, and neighbors, a large variety of the practical things of life.

An ever-increasing number of professions and occupations require for success good elementary and higher education, and professional and

technical training for which general education forms a necessary basis. The proportion of highly educated men and women required even in subordinate places in professional, commercial, and industrial life increases constantly and rapidly. It is almost impossible to find employment without education. A diploma is a letter of credit addressed to the world.

What is the challenge of the future? Students now in school must take up tasks left unfinished by their parents, complete them, and undertake new and greater enterprises. Scientific discovery and the organization of knowledge are just begun; men are only learning how to discover and organize. In all phases of knowledge, gripping and thrilling discoveries will be made by those who are prepared (13, pp. 13-16).

Education is of value because it offers the fullest opportunity to live long, happily, and well; to enrich one's life and the lives of others, and to leave the world better for one's having lived in it.

Mr. Kenneth A. Meade, Director, Educational Relations Section, Public Relations Department, General Motors Corporation, Detroit, Michigan, makes the following statement with respect to the type of college graduate desired by a manufacturing industry.

> Education and industry have the same ideas in mind with respect to the training students receive.
>
> It is their experience that the accredited institutions of higher education are generally doing an excellent job in giving their students a fundamental background on which to build experience when they take their place in industry and in life. Education by itself will not give the graduate an escape from routine, from hard work, from responsibility or the possibility of economic difficulties. It will not guarantee him economic security, success or happiness in

> his job. It can, however, train him to work with his hands or with his brain or both. It can help him to develop a willingness to accept responsibilities as regards his job, family, and fellow citizens, and it can help him develop an ability to make adjustments in getting along with and living in a friendly and peaceful manner with all of the people with whom he is associated.
>
> When educators speak to business or industrial groups, they quite frequently discuss methods used in schools which develop the student, which, in their opinions, can best fit the students to take their place in society. They will probably refer to 'life adjustment programs,' 'evaluation techniques,' 'progressive methods,' to the needs of the students.
>
> From the standpoint of representatives speaking to a group of educators on a subject such as "What does business and industry expect of the schools," we find that they will probably make frequent use of such terms as 'fundamentals,' 'good citizenship''teamwork," and 'good working habits.' They no doubt have developed 'yardsticks' which they feel can be used as a means of measuring how well students—the products of the educational institutions—are prepared to enter the working world and take their place in adult society.
>
> Now if we stop to analyze the real meaning of what each has said and take into account the backgrounds of experiences and viewpoints of each, we find that both groups do have fundamentally the same ideas in mind. The same points are usually stressed by each, but the terminology of each group is quite different (7, p. 484).

According to Mr. Meade, very few unsuccessful college graduates in industry failed to progress because of insufficient technical skill or ability. Many have been found lacking in personality or personal characteristics and because of their lack of development they are classed as professional failures. Industry tries to avoid such mistakes by placing most of the emphasis in their interviews on the observation and appraisal of the applicant's attitudes and personal qualifications.

Industrial leaders look for graduates with above average mental abilities because they will be up against stiff competition. They want individuals who are physically, mentally and emotionally mature. They are interested in graduates who have demonstrated that they are good team workers; who show a spirit of cooperation; and who have developed an attitude of service rather than the feeling that industry owes them a position or a livelihood. Industry is much more interested in the graduates who want an opportunity to compete with others like themselves for whatever responsibilities that may come their way rather than graduates who express a primary interest in the security of the job and pension plans before they are placed on the payrolls.

Large corporations are organizations of many people in which no single individual is apt to reach his personal objective without the voluntary cooperation and assistance of his associates. Experience has demonstrated many times that the degree of cooperation is determined by the personality factor more than any other thing. Modern industrial progress depends on teamwork to such a degree that graduates must be able to submerge their individuality to a considerable extent in order to become effective members of that team. As a member of the team they must be capable of making their own contributions, yet be flexible enough to change their own ideas as new thoughts are presented to them by other members of the group. Few indeed are the industrial positions wherein employees can work as 'lone wolves.' If they honestly wish to progress, they must be able to adapt themselves to the organization in a wholehearted manner. They must learn to work with people

until their responsibilities increase to such an extent that the major requirement is for people to work with them (7, pp. 484, 485).

Trends in training needs at the technical level

How science in general, and technology in particular, is to play an expanding and more potent future role in both the management and technique of industry and business has been the subject of many recommendations and suggestions, and the cause of one major controversy. The question is whether increased facilities for education and research in technology should be provided inside or outside existing colleges and universities (8, p. 464).

The primary purpose of a technical institute is to give occupational preparation designed to meet the needs of industry and of youth. A graduate of the institute must be able to earn a living, to exercise intelligently his rights as a citizen, to understand his responsibilities as the head of a family, and to understand the world in which he lives. This may seem like a large order for a two-year program. It is a large order for any school--institute or college. But the size of the order must not be allowed to frighten schools into limiting their programs to just one of these purposes at the expense of the other. Each is important in a democracy, and all should be stressed.

For one thing, the graduate must be able to communicate effectively. This means not only good reading and listening, but also effective speaking and report writing. These skills are usually required if a person is to do a good job (1, p. 12).

John S. Allen, Vice President, University of Florida, states the following with regard to technical institute programs:

> Vocational skills taught in a Technical Institute are likely to be in the physical and biological sciences. More specifically, they may be related to electrical engineering, mechanical engineering, sanitation, or some similar field. The candidate may not always get a job in a related field. Therefore, he needs a background of general education so that he will not be too narrowly educated, and so that he will have an understanding of the world in which he lives.

The New York Times for October 4, 1952 quoted Albert Einstein as saying:

> It is not enough to teach a man a specialty. Through it he may become a kind of useful machine, but not a harmoniously developed personality. It is essential that the student acquire an understanding of and a lively feeling for values. He must acquire a vivid sense of the beautiful and the morally good.
>
> Otherwise he--with his specialized knowledge--more closely resembles a well-trained dog than a harmoniously developed person. He must learn to understand the motives of human beings, their illusions and their sufferings in order to acquire a proper relationship to individual fellow men and to the community.
>
> This is what I have in mind when I recommend the 'humanities' as important, not just dry specialized knowledge in the fields of history and philosophy (1, p. 12).

Mr. Allen makes further comment on technical institutes with respect to its emphasis on the student.

> The general education course in a technical institute is not designed to start a student on a route that will ultimately end with the Ph.D. degree. Instead, emphasis must be on the student rather than on the subject. Learning must be cast in the proper setting and balance for the socio-economic-politico world in which one lives. Basic principles would be emphasized with enough facts and data to illustrate the principles and to make them understandable (1, p. 13).

Frank J. Johnson, Manager, Personnel Units, Lockhead Aircraft Corporation, Marietta, Georgia, in an article written for Technical Education News, states that the technical institute level of training

is one of the answers to industry's supervisory problem. That graduates of technical schools should have the basic scientific training, including technical 'know how' and the supervisory and management training needed for potential managers and supervisors in industry. He further states that the technical training course should include the supervisory-development phase plus basic sciences plus basic engineering fundamentals, and that theory be combined with actual practice in the lab and in the field.

Elective courses needed by graduates

Edwin S. Burdell, President, The Cooper Union, in an address entitled, 'Grease Monkeys or Citizens?' recognized the need for the schools to produce more engineers, and of the great interest and need for the technician.

In his address he makes the following statements:

> From a philosophical as well as from a practical standpoint, students from the technical institutes are strongly needed. The well-publicized shortage of engineers makes a tremendous demand on the technical institutes to increase their output. A recognized need exists for the 'in between' group--between the craftsman who will never go beyond using his hands, however skillfully, and the man with the capacity to design and to do creative work.
>
> Present-day living requires preparation for life as well as for earning a living. Therefore, there is a need for broader objectives in technical institute training. There must be motivation for participation in a democratic society, and it is just as much an obligation on the part of the technical institutes to assume that responsibility as it is to train men in a particular technology.
>
> It cannot be taken for granted that young citizens are going to adjust harmoniously to human relations in the shop, in the community, and in the home; that they are going to be familiar with the helpful modern concepts of family life; that they are going to make intelligent choices of candidates for office; that they can exercise good judgment in accepting

> or rejecting proposals for community improvements, especially in matters of public schools or in matters affecting our fundamental political organizations, constitutional changes, and so on.
>
> Nor is it certain that they can discriminate between good or bad leadership in their trade unions and in their social organizations or be able to cope with situations that involve racial and religious difficulties. Areas of tension in American communities are definitely slowing up industry and good society because people are not familiar with the present-day methods of coping with racial and religious difficulties.
>
> Technical institutions must develop in graduates, whether sub-professional or professional, an everlasting interest in the common welfare and the cultural aspects of community life. There should be no distinctions in the matter of enjoyment of a good life. A man in the lower income bracket will enjoy and will benefit from a knowledge of good music, artistic expression, and the development of his personality through adult education. He is just as much entitled to these things and no doubt has just as much to offer and contribute as the man at the professional level (3, p. 2).

The technology student should choose as elective courses those subjects that will help give him a background in social science, politics, and social philosophy.

Statements of Mr. Allen's further supplement Mr. Burdell's address:

> To be successful, the classes in the technical training course must be well integrated. But no matter how well teachers are merely a group of specialists. A class should be small, and should have one instructor the entire semester. There must be time for questions and general class discussions. The teachers on the staff should be the best trained people available. Advanced students may learn in spite of poor teaching, but freshmen who are being introduced to new concepts need the best instruction available.
>
> To implement these ideas the technical institute should set up a series of general education courses in (1) communications, (2) the history and the economic and sociological implications of American institutions, (3) the humanities,

> (4) the natural sciences, and possibly other related fields. The majority of the students would be expected to take most of these courses. But, recognizing individual differences in preparation, in ability, in achievement, the procedures would be flexible enough to serve each student's needs (1, p. 13).

The curriculum as set up in the Automotive Department at Utah State Agricultural College allows for 18 hours of elective classes. The student is expected to take advantage of these hours and take the classes that are related to the 'humanities' as well as those classes related to his technical training.

Industrial demands of graduates

Industry is vitally concerned with today's youth, for it knows that they will become the industrial leaders of tomorrow.

High school graduates who are looking forward to technical work should take all the chemistry, physics, and mathematical courses that they possibly can. They should also be sure of their aptitudes for these fields. They should also keep an open mind on research, and not decide too soon between research in pure science and engineering. Some men are more interested in theory than in practice, and they are just as important to industry as the others. In fact, industry is only beginning to awaken to the necessity for supporting basic research, according to Dr. Robert E. Wilson, Chairman of the Board of the Standard Oil Company in Indiana.

However, the student interested primarily in research ought not to neglect the humanities. "We would suggest," said R. G. Pearson, Shell Oil Company, "that in high school and college the student take as many credits as he can in the humanities--history, literature, langugages, philosophy, art, etc.--courses enabling him to understand

the attitudes and forces that have shaped the world in which he lives and in which he will put his scientific training to use." (13, p. 14).

Dr. Howard E. Fritz, Vice-president in charge of research at the B. F. Goodrich Research Center, stated that training for the higher technical jobs in their company should include a full college curriculum specializing in chemistry, physics, or chemical engineering. "Other useful qualifications," Dr. Fritz pointed out, "are a reading knowledge of French and German, and an ability to express ones-self clearly in written and oral English. Desirable qualities of character are imagination, flexibility, and patience" (15, p. 15).

It has also been pointed out by several industrial leaders that general reading on scientific accomplishments, and active development of technical hobbies are the best possible stimulants to the proper selection and the future pursuit of a scientific career.

Dr. R. P. Dinsmore, Vice President of the Goodyear Tire and Rubber Company, makes the following comment:

> No one should select a scientific career because he thinks it is an easy way to make money. It is true that well-qualified scientists and technologists are in great demand, and probably will be more so in the future. However, one should not choose this field unless he can combine both a genuine interest with a reasonable aptitude for subjects which attract him (15, p. 15).

Mr. C. L. Austin, President of the Jones and Laughlin Steel Corporation, comments on the hazards of overspecialization:

> We are looking to higher education for furnishing good teaching of basic fundamentals of the sciences, the so-called humanities, and the arts. A person of my generation usually has to go through the mill with his children to be able to translate the fancy new vocabulary of education into the old language which treated

with mathematics, history, geography, philosophy, arts and the old fashioned variety of sciences.

> In our company we are vitally concerned with obtaining college graduates who have developed a respect for God, a respect for the fundamental moral law and a respect for the attributes of our nation which so far have been able to keep her strong. In fact, I am pleased to emphasize that we regard these qualifications in a young man more highly than the qualifications derived from a specialized learning. If a boy has a healthy and positive attitude toward his life and toward his responsibilities to himself and his fellows, and if he has demonstrated satisfactory scholastic accomplishments in a good college--then we are confident that he can acquire the specialized knowledge he will need for his work in our company (2, p.550-551).

Mr. Kenneth A. Meade, Director of Educational Relations Section, Public Relations Department, General Motors Corporation, states that much of the executive effort going into the development program at General Motors, as far as college graduates are concerned, aims at the goal of influencing and correcting personality and professional characteristics which, if left unchecked, could and probably would have an adverse influence on the individual's future progress in the organization.

Mr. Meade says with respect to schools:

> Whenever possible, use practical instructional materials that are available from business and industry as case examples to acquaint the student with what he will encounter in a job so that the adjustment from college to industry will be easier.
>
> Help the student to develop the habit of periodically making an inventory of his abilities, interests, and personal qualifications so that he can make an intelligent choice of a career. Let him proceed as fast in obtaining his formal education as his health and ability will permit.

Since much of what the student learns in school and later on the job as an employee and in his everyday pursuits will be leaned from his observation of the way people do things, he should be trained as early as possible in how to observe and how to evaluate what he observes.

Finally, we hope that you (speaking of colleges) will continue to emphasize the importance of English, report writing and oral expression. These not only help to develop well-rounded individuals, but will make him better able to sell himself and his ideas.

To summarize, we believe that the essential components of a successful career in General Motors can be reduced to just three requirements on the part of the young graduate.

1. Native abilities such as health, energy, imagination, intelligence, initiative and comparative characteristics.

2. Ability to use the known laws of the arts and sciences—as you have taught him to do in his formal education.

3. An understanding and ability to apply the 'unwritten laws' by which his own efforts are integrated into the large field of industrial endeavor (7, p. 487).

REPORT OF QUESTIONNAIRE RETURNS

Evaluation of program by former students

Responses to the questionnaire. A total of 94 students have graduated from the Automotive Technology Department at Utah State Agricultural College during the years from 1950 through 1954. All but seven of these graduates were sent the questionnaire, the seven being omitted because no address was available. By means of follow-up letters and personal contact, it was possible to get a return from 48 of the graduates, giving a 55 per cent return of the questionnaires.

Question number 1 asked the students whether the curriculum completed in college helped in procuring their present jobs.

Students returning the 48 questionnaires indicated the following:

There were 79 per cent of the returns answered yes, 15 per cent no, and 6 per cent made no comment.

Some of the comments received from students who answered no to this question are:

1. "Fellows out of high school were doing the same jobs as they were."
2. "They have the same job after graduation as they had when they entered college.
3. "They are now in the service."
4. "They are working in jobs entirely foreign from the field in which they graduated.

Question number 2 asked the graduates if there were other classes that they had not taken that could be added to the curriculum which would be advantageous to future graduates. The following is a list of classes that were suggested by 85 per cent of the returned questionnaires and the number of times each class was mentioned.

Classes Suggested	Number of Times Mentioned
Higher mathematics	17
Engineering	6
Business	4
Physics	4
Machine design	3
Materials testing	3
Psychology	3
Speech	3
Chemistry	2

In addition, many other classes were listed which are now in the present curriculum. A few personal notes were added in connection with the above mentioned.

1. "Some classes could be more specialized and organized so more could be comprehended from them."
2. "As long as technology graduates are going to accept engineering positions and as long as Industry is content to hire them as such it will be to the benefit of both to have more math, more engineering drawing, and possibly more engineering classes covering such things as stress analysis and design work."
3. "It should be an engineering degree or cut the engineering classes and add classes that will benefit the student for future employment."

4. "The problem is not classes to be added or dropped, but where do they lead to?"

Question number 3 asked if there were subjects in the curriculum that were unnecessary. Fifty-eight per cent of the students returning questionnaires felt that all classes in the course had proved to be beneficial, while the remaining 42 per cent felt that there were subjects that were unnecessary.

Some of the comments to this question were as follows:

1. "All of the classes should be changed to mechanical engineering classes with an automotive option for the final engineering degree."
2. "Any subject matter regardless of content has some value."
3. "All helped in a well-rounded education."
4. "It is my opinion that any college class benefits an individual in obtaining a well-rounded education, but naturally certain classes are more important in attaining a final goal.
5. "All have some value but one should specialize more in some line of work."

Question number 4 asked the graduates if there were classes in the curriculum that they felt should be strengthened. All classes in the curriculum were mentioned with respect to this question.

Question number 5 asked if there were classes that should be omitted. There were 56 per cent said that none should be omitted, while 44 per cent made no comment to the question.

Comments in connection with the question were:

1. "I feel that more emphasis should be placed on the exact sciences so that the background of the technologist more closely parallels that of the engineer."
2. "All are good and have some application, especially for teachers."
3. "I feel they are all quite necessary."
4. "Depends entirely on individual students desires, abilities, and the curriculum demands."
5. "The included curriculum seems to cover the scope of the course in such a manner as to prepare the student for most of the problems he will meet in industry. Experience however, will always have to strengthen, mellow, and improve all of us."
6. "Some of the basic automotive courses could be combined so as not to put in so much time on them as is required in separate classes."

Question number 6 referred to the practicality of the curriculum. It was found that 52 per cent of the graduates felt that the present curriculum was as up-to-date as it could be; 48 per cent felt that it could be brought more up-to-date in shop equipment and laboratory instruction.

Comments received with respect to this question were:

1. "Classes in theory were satisfactory, but practical experience on up-to-date automotive equipment was inadequate."

2. "Classes were up-to-date but could have been strengthened in the covering of new developments."

3. "It seemed we moved to slowly waiting for the 2-year men to keep up."

4. "Most programs can always be brought up-to-date more frequently than they are."

5. "Some classes were poorly organized and little real value was gained because too much time was spent on unimportant subjects and not enough on the practical matters."

In question number 7 the graduates were requested to evaluate their education with respect to how adequately it prepared them for each of five professions: mechanic, shop foreman, salesman, business manager, and instructor.

Tabulations are as follows:

Profession	Number Qualified
Mechanic	28
Shop Foreman	26
Salesman	13
Business Manager	7
Instructor	24

Many graduates added a personal comment or personal letter to the questionnaire which helped to express their opinions about the classes in the curriculum and the course in general. (These comments are found in the Appendix)

Evaluation of program by schools

Response to the questionnaire. The questionnaire was sent to 33 schools throughout the nation that were teaching automotive subjects. These included vocation schools, technical institutes,

and mechanical engineering schools. These different schools were contacted for the purpose of determining the value of the automotive training program at the Utah State Agricultural College. It was possible to get a return from 14 of the schools, giving 42 per cent return of the questionnaire. Since many of the questions were unanswered, and since letters were often sent in lieu of the questionnaire, it was necessary to compute results on the basis of schools reporting to the particular item in question.

Comparison of program by schools. Question number 1 asked the schools was whether they felt the Utah State Agricultural College program was comparable to that of their own school. There were 28 per cent answered yes, 36 per cent answered no, and 36 per cent added comments. Comments indicate that the programs do not compare closely in content, method, facilities or objectives. A letter sent by the University of New Hampshire, for example, states that they are considering making trigonometry an entrance requirement for candidates for the bachelor of science degree in the College of Technology. This would enable their students to start their college mathematics with a course in calculus.

To illustrate a difference in the attitudes that schools take toward certain classes, in the course in internal combustion engines, at the University of New Hampshire, the class meets for lectures twice a week during the senior year only. The Utah State Agricultural College course in internal combustion engines meets three days a week during the freshman year for a one-hour lecture followed by a three-hour lab. In the classroom the University of New Hampshire stresses

analysis of problems based upon previous courses in thermodynamics, mechanics, physics, chemistry, and mathematics. Classroom work in the Utah State Agricultural College program covers the theory and construction of the internal combusion engine. Laboratory work for this subject at the University of New Hampshire stresses the analysis of results and report writing, while laboratory work at the Utah State Agricultural College stresses engine overhaul, maintenance, and repair.

A return from Washington State College mentioned that for some years they had offered two mechanical engineering courses which covered work in automotive mechanics, but dropped them in 1953 and replaced them with one class on a higher level.

Question number 2 asked the schools whether there were any subjects in the Utah State Agricultural College program that they felt should be eliminated. There were 28 per cent that indicated there were some subjects that could be eliminated, 36 per cent reported there were none to be eliminated, and 36 per cent made no comment.

Of the 28 per cent that felt there were some subjects that could be eliminated, none listed any subjects.

Question number 3 asked whether there were classes not in the curriculum that should be added. There were 28 per cent answered yes, 36 per cent answered no, while 43 per cent made no comment.

Suggested subjects to be added were electrical fundamentals, chassis dynomometer operation, and enough engineering courses to justify a bachelor of science degree.

Question number 4 asked whether the program was deserving of a bachelor of science degree. The answer to this question was 36 per cent yes, 28 per cent no, and 36 per cent added comment to the question.

Comments noted in connection with this question indicated that a bachelor of science degree could be granted only on a technical institute level.

Question number 5 asked whether the program qualified the students for responsible positions in industry. Comments on this question were 85 per cent to the effect that the graduate could be given more responsible positions in industry provided the responsibilities did not go beyond the duties of a technician, 14 per cent stated that graduates could not be given responsible positions in industry.

Question number 6 asked for changes, suggestions, or improvements that could be made in the program which would benefit the student. Approximately 64 per cent of the returns made no comment with respect to the question. The remaining 36 per cent suggested the following changes and improvements:

More machine work in a machine tool laboratory
More trade experience
New and better system of screening students
Development of more student responsibility
Change to classes on a more technical level

The above suggestions applied only if the courses were operated on a technical institute level.

Question number 7, the last on the questionnaire, asked for a commentary on the positions for which the graduates might qualify.

The following tabulation shows the percentage of people answering the questionnaire who felt that the graduates were qualified for the positions specified.

Mechanic	57%
Shop foreman	36%
Salesman	1%
Business Manager	0%
Instructor	6%

From the above percentages it can easily be seen that mechanical engineering schools feel that the Utah State Agricultural College is training students for the field of mechanical work only.

Questionnaires returned by trade schools qualified the graduates for any one, or all of the positions listed above.

The schools that are teaching on a trade training basis feel that the Utah State Agricultural College program is much more academic than the ones they have, and as a result they were reluctant to make comments or criticisms on the program. The trade schools stated that there is definitely a large gap between the two programs. The vocational schools are attempting to follow the true vocational training program as it is written in U. S. Bulletin #1.* They are also of the opinion that the day is not far off when many trade schools which are connected with colleges and universities will be swinging back to true vocational training programs.

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*Policies and recommendations for the administration of vocational education programs under the provisions of the Federal Vocational Education Acts. (Vocational Education Bulletin No. 1, General Series. No. 1 Revised 1948). Federal Security Agency, Office of Education, Washington D. C. 1949.

Evaluation of program by industrial leaders

Response to the questionnaire. There were 30 questionnaires sent out to industrial units and to those organizations which might have an interest in automotive graduates. These included all leading automobile manufacturers, heavy equipment manufacturers, engineering departments of military installations, petroleum manufacturers, and the Department of Health, Education and Welfare of the U. S. Office of Education. It was possible to get a 50 per cent response to the questionnaires sent to these organizations.

Because of the nature of the response it was necessary to analyze the results of this section in terms of general statements concerning the questions.

Acceptance of program by industry. From the automobile manufacturers' point of view, the automotive training program at Utah State Agricultural College seems to be preparing the graduate for employment in automotive dealerships rather than engineering departments of the manufacturer.

From this standpoint courses in speech, psychology, operation and management of automotive dealerships, business law, and principles of merchandising would be of additional value, replacing the courses in engineering drawing, chemistry, and welding.

The service section of General Motors Corporation breakdown the area of automotive instruction into five general groups. They are automotive hand tools, automotive chassis, automotive engines, automotive electrical and automotive service. They recommended that

automotive electricity, automotive physics, and the use of hand tools be taught during the first year of study.

The General Motors Company has a Dealer Cooperative Program at the General Motors Institute at Flint, Michigan, which is a two-year program attended by selected men from General Motors dealerships all across the country.

The General Motors Dealer Cooperative Training Program is planned to provide the student with as broad and as firm a foundation as possible by alternating periods of work and study. A General Motors Dealer, during work periods, provides the student with the opportunity to learn by actual experience the work of a dealership, while the Institute, during school periods, provides the student with the theoretical background. In addition, a series of reports written by the student covering his actual experiences in the dealership, coordinates the two phases (6, p. 2).

The automotive industry feels that all the subjects in the curriculum are of great value to the student and that none should be eliminated. The automotive industries stressed the need of automotive dealers throughout the United States for college graduates with the background and training that such a program of this type provides.

The Plymouth Division of the Chrysler Corporation expressed the opinion that their division is impressed by the thoroughness of the training in the automotive course taught at Utah State Agricultural College and feel that a certain number of graduates with this background would be useful in factory laboratories and experimental road testing operations.

Mr. L. R. Baker. Director Chrysler Institute of Engineering, makes the following statement with respect to the questionnaire:

> A review of the course descriptions would indicate that the curriculum provided a very complete coverage of automotive vehicles from the operating and repair standpoint and certainly men with the background thus provided should be useful to automobile dealers in the field. A certain number of men with this background would also be useful in factory laboratories and experimental road test operations.

The Caterpillar Tractor Company employes each year many graduates from branches of engineering, primarily mechanical, electrical, civil and metallurgical. These men with their professional degrees have fit well into research, design, sales and service activities of their company.

Caterpillar's needs for men trained at a more practical level are normally filled by graduates of one of their four-year apprenticeship programs. They stated, however, that their dealers and the large contractors who use their machinery might well be very interested in young men with the type of training provided in the Automotive Technology Department at Utah State Agricultural College.

Caterpillar's training program is recognized throughout the United States. Each training course is broad enough to assure the graduate's ability to compete favorably in his particular field.

Apprenticeship courses offered are: machinist, toolmaking, foundryman, wood patternmaker, electrician, metal patternmaker, heat treater, pipefitter, and millwright.

Training courses offered are: engineering draftsman, business, machine shop, sheet metal, and welding.

International Harvester Company does not believe that the level of instruction in the Automotive Technology program at Utah State Agricultural College justifies the awarding of a bachelor of science degree. They feel that many of the subjects covered could just as easily, if not better, be covered by actual on-the-job training or through a cooperative program of some sort, with classroom courses pitched at the college engineering level rather than at or about the technical institute level.

The Recruitment and Placement Branch of the San Francisco Naval Shipyard makes the following comment with respect to the questionnaire.

> The San Francisco Naval Shipyard does not employ any sizeable number of automotive mechanics; however, it is the opinion of our Engineering Department that the curriculum offered is very good for the sub-engineering level and should ideally suit the student for employment in organizations having motor pools or large Mobile equipment demands (10).

The Recruitment and Placement Branch stressed the need for the type of education outlined in the curriculum, and stated that should a graduate of the Utah State Agricultural College make application for employment with them that the applicant would be given careful consideration.

The Board of United States Civil Service Examiners stated that the curriculum provided excellent training for a prospective automotive project engineer.

The Board of Examiners stated that they felt the curriculum provided satisfactorily the training necessary for employment as Engineering Aids, and stressed the need for the type of education outlined

in the program. They stated that in order for the curriculum to be totally deserving of the bachelor of science degree that the curriculum should be strengthened by the addition of engineering classes, and with the deletion of some of the shop courses. Suggested subjects to be added to the curriculum would be: engineering mechanics, strength of materials, machine design, engineering testing, and technical writing.

A letter from Henry H. Armsby, Chief for Engineering Education, Vocational Education Division of the Department of Health, Education, and Welfare, Washington D. C., made the following statement with reference to the questionnaire and curriculum offerings:

> I have looked over the curriculum which accompanied your letter and, with my limited knowledge of such matters, I think it ought to do a good job of training the sub-professional.
>
> It appears to be an outline of a college level course. It does not provide for actual work experience in the trade which is a requirement in trade and industrial education.

The Phillips Petroleum Company reports that the curriculum appears to provide satisfactory training toward employment in their company. They also consider the completion of the curriculum deserving of a bachelor of science degree. They feel that there is an outstanding need for the type of education outlined in the curriculum. They feel that a thorough study of fuel and lubricating oils would be of considerable value in strengthening the present curriculum.

With respect to employment needs, they stated they would welcome applications for employment from the automotive graduates of the Utah State Agricultural College.

CONCLUSIONS

Summary

Opinions of industrial leaders. Good elementary and higher education is required if a student is to succeed in the ever-increasing number of professions, occupations, and technical positions.

Without education, it is almost impossible for men and women to find employment in industry.

Education alone will not give the student an escape from hard work, responsibility, economic difficulties, success or happiness in his job, but it can train him to use his hands and his brain, which will help him get along with his associates.

Lack of personality and acceptable personal characteristics are generally the cause of industrial failures among graduates rather than insufficient technical skill or ability.

The graduates with above average mental abilities and those with physical, mental, and emotional maturity are the ones industry is looking for.

Industrial progress depends on teamwork, so much so that graduates must be able, above all, to get along with each other to become effective members of an organization.

Graduates of technical institutes must be able to exercise intelligently their rights as citizens and understand their responsibilities to their families and the community in which they live.

Technical institute courses should be well integrated, small, and staffed with the best trained people available.

High school and college students should take all the chemistry, physics, and mathmatics courses that they possibly can if they are looking forward to technical work. The students should also take as many credits as they can in the humanities in order that they might better understand the world in which they live.

Students in the technical institutes should not select a scientific career because they think it an easy way of making money. They should have a definite interest in and aptitude for technology.

Industry is vitally concerned with obtaining college graduates with respect for God and moral laws.

School should strive to teach the 'fundamentals' and let industry itself help the graduate in its employ to continue his training and development.

Students should be taught how to increase their powers of observation and how to evaluate what they observe.

Analysis of acceptance by industry. Questionnaires returned from industrial organizations agreed that graduates from the Automotive Department of the Utah State Agricultural College are well qualified in industrial technology. They recognize the value of the type of training the graduates receive and stressed the outstanding need for the type of education outlined in the curriculum, and they are willing to accept applications of such graduates for employment in their organizations.

The automotive industry is willing to accept the program as it now is, and feels it deserving of a bachelor of science degree, while other organizations in related fields stressed the need for more classes on an engineering level to qualify the course for a bachelor of science degree.

Analysis of comparison by schools. It has been determined through the use of questionnaire results that the automotive training program offered as part of the regular course at the Utah State Agricultural College is not rated as highly as are automotive courses offered at mechanical engineering schools, but that the level of the training program is on a much higher academic scale than those of vocational schools and would better meet the vocational and technical demands of industry. The course is especially effective in giving the graduate a more thorough, well-rounded educational background as well as developing a greater ability to use both his hands and his brain.

Analysis of type of response by graduates. Approximately 60 per cent of the 94 students that have graduated from the Automotive Department from 1950 to 1954 have been out-of-state or foreign students. These students came to Utah State Agricultural College to major in automotive technology because they knew of no other school in this field that offers a bachelor of science degree on a sub-engineering level. The course is similar to those in other schools, but most of the automotive training offered is on a trade program level or at a mechanical engineering level. The automotive training program at Utah State Agricultural College is unique inasmuch as automotive technology is offered as part of a regular college course.

The type of graduate response received is no doubt conditioned by the present position of the graduate sending in the questionnaire. It seems quite apparent that those working in industry definitely realize the need for more study in the engineering field. Those who are in business emphasize the need for more training in business administration and its related subjects. No matter what field the graduate is now working in, the response to the questionnaire in each case expressed the apparent weakness or shortcoming the graduate now feels with respect to his work. Of all the questionnaires returned, there was only one that made reference to the entire automotive course as being an absolute waste of time. It is noteworthy that the student admits that he was poorly advised while in college and that he is now doing work that is totally unrelated to his college training.

The majority of the graduates were of the opinion that the degree they received in industrial technology was ideal for those who wanted to enter the automotive service field as mechanics and sales service personnel. Most of the graduates, however, have wanted to go higher up the ladder and have realized since graduation that they should have taken more classes in the mechanical engineering field in order to compete with men working in the field of mechanical technology and engineering. These graduates now realize how important the classes were that were outlined for them when they started college and the importance of taking the classes more seriously in order to receive full benefit from them and not merely as a means to an end.

Some students commented on the falsely optimistic notion they had prior to graduation that the diploma itself was of prime importance and would automatically lead them into lucrative employment without their exerting further initiative or acquiring additional information in their fields.

Others regretted that they had not heeded the counsel of their advisers and had found fault with classes they were required to take to graduate.

After they graduated and found jobs they realized that the classes they did not have to take and managed not to take were often the ones that would have meant the most to them.

The graduates felt that there is need for more laboratory work, with more instruction given on the use of special equipment, also a need for better counciling and student-instructor relationship. Only after graduation do students realize the true value of all the courses outlined in the curriculum.

As a general rule the curriculum was accepted as being instrumental in giving the graduate the educational requirements for his present position.

Most of the graduates were inclined to agree that all courses are at some time well worth the time and effort spent in taking them.

Evaluation

Need for technical education. Technical education is that phase of education which prepares men for jobs in which technical skills related to engineering are emphasized. The automotive training program at the Utah State Agricultural College plays a part in this

phase of technical education.

Graduates of technical curriculums are assigned to work as members of an engineering or scientific team in research and production planning, and in the designing, constructing and maintaining of materials and machines of the nation's mass-production economy (6, p. 201).

It is true that the functions of engineers and technicians may overlap in practice. For example, an engineer in one plant may perform the duties that a technician may perform in another plant. However, there is a line of demarcation that is clear to each. The engineer understands the functions of mathematics, physics, research, design and chemistry; the technician also knows mathematics, physics, and chemistry, but he uses his knowledge in performing calculations, running tests, and in making estimations and diagrams.

The engineer plans, the technician makes and does. Whatever the engineer creates and projects, the technician operates.

The technician is primarily concerned with <u>how</u> to do a job; the engineer with <u>why</u> to do it (4, p. 11).

C. J. Greund, Dean, College of Engineering, University of Detroit states:

> The technician is auxiliary to the engineer. This must be clear if the relation of the technician to the engineer is to be understood. Some technical institute people have objected to mention of this auxiliary status as implying some kind of dishonorable inferiority. In my view, there is no real basis for this feeling, and I believe it is disappearing. After all, we have higher and lower orders throughout our social and industrial organization. There is nothing dishonorable about being a first-class machinist and not a foreman. There is nothing dishonorable about being a superintendent and not a works manager. There is nothing dishonorable about being a salesman, not a sales manager; or a nurse

> and not a surgeon; or a high school teacher and not the principal; or a sargeant and not a commissioned officer; or a son and not his father and head of the family.
>
> If the auxiliary relation of the technician to the engineer is not understood and accepted there is no chance, in my opinion, for the proper development of technical institutes. Of course, we have in the United States no fixed occupational classifications. Any technician can become an engineer by meeting the well-known qualifications (4, pp. 11-12).

There is a shortage of technicians in industry today. The need for them is increasing at a rate far greater than facilities for training them.

John T. Rettaliata, President of the Illinois Institute of Technology, believes that:

> In this country the schools are getting away from specialization in their engineering programs. They are including more humanities courses in their curricula. That in a world of increasingly complex technology, where new developments are occurring at an expanded rate, it is becoming more difficult to prepare a student adequately at the undergraduate level (8, p. 135).

There seems to be little hope for an increase in the supply of trained technicians in the immediate future; therefore, an immediate and continuing expansion of training facilities for technicians is urgently needed.

The present curriculum at the Utah State Agricultural College appears to contain the necessary courses required to give this needed training as well as to give the student a well-rounded education--an education which will qualify him to take his rightful place in the world in which he lives.

Results of this study would also seem to indicate that with its present aims there is little need for radical changes to be made in

the curriculum of the Automotive Department at Utah State Agricultural College, but that the proficiency of the courses might be increased through the addition of higher mathematics, physics and more engineering classes. The program appears to lead to a well-rounded education that industry feels is desirable.

In the questionnaires evaluated in this study by the various schools, constant comparison was made of the curriculum at the Utah State Agricultural College with the curricula of schools of engineering rather than on the sub-engineering level. Industry and the graduates of the Utah State Agricultural College Automotive Department both stressed the worth of the curriculum as it now is and called attention to the ever-increasing need for this type of varied education in today's industrial world.

In addition to serving industry the school must serve the individual student. What a student thinks of the education he is getting and what an alumnus thinks of the education he has received are very important, especially when these people reach positions of great responsibility in industry.

Answers to the questionnaires would seem to indicate that the Automotive Department at Utah State Agricultural College is living up to its objectives of furnishing adequately trained people who at the same time maintain a cooperative and democratic attitude toward their work and their fellow men, an attitude repeatedly mentioned by the personnel experts in industry as the most highly desirable qualification for success.

Recommendations

Although no criticisms were made with sufficent frequency to indicate that major changes are needed in the Automotive Department to compensate for serious shortcomings, certain recommendations might be considered for the purpose of strengthening the work of the department. Most frequently mentioned were the suggestions:

1. To add more mathematics courses, particularly calculus.
2. To permit more student experimentation through more extensive use of college facilities.
3. To improve job placement procedures.
4. To improve teaching methods and teacher-student relationships in certain areas.
5. To emphasize more the principles of engine testing and design.
6. To select more courses leading to technical and engineering classes.
7. To reduce the number of 'shop courses' in favor of the engineering classes.
8. To encourage students to work for a teaching certificate.
9. To consider the inclusion of more courses in the humanities in order to broaden the cultural backgrounds of the students and prepare them for the job of making sound adjustments in personal relationships, a matter considered by some authorities to be more important than technical training.

(Several quoted opinions that were added to the questionnaires are to be found in the Appendix).

In general, despite the fact that several individuals faults were pointed out in the present program, the consensus both of the former graduates and leaders in industry is that the educational offering

of the Automotive Department of the Utah State Agricultural College is well designed to give the student a well-rounded education and fit him adequately for a successful career in a variety of industrial positions.

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APPENDIX A

ADDITIONAL COMMENTS SUBMITTED BY STUDENTS WITH RESPECT TO THE PROGRAM

1. "Colleges of today give us a general education. It may be best but there should be a few more vocations to specialize in.

2. "Students should be familiarized with other fields, such as Aircraft and actual Engineering. Most of the Utah State graduates here at Boeing are actually in the engineering department."

3. "I think more emphasis could be made in the last two years on aiding students to experiment on individual projects. Possible inventions could receive more aid and encouragement by allowing the student more use of college facilities.

"Better job placing contacts would assist students in finding work more readily in their field.

4. "With just a few added courses a student would be able to more easily enter into the industrial field.

"The practical work in the shop is the most valuable part as far as I am concerned. So many graduates in this work are 100% on theory but have no practical knowledge whatsoever."

5. "Most of the subjects required for the Bachelor of Science degree in automotive are very good but in a few cases the person teaching them has caused the class to be a failure.

"Most of the program was up-to-date with the exception of some classes in the other departments. The auto classes were

more up-to-date than many similar classes in the various high schools and vocational schools.

"I believe that more emphasis could be placed on engine testing and analysis as well as on design principles (mainly mechanical).

6. "I think the present curriculum is fine for the purpose for which it was set up. However, with the demand for engineers running at its present high level it looks like a pretty good time to work on raising the program closer to an engineering degree if the aspirations of the 'powers that be' are inclined in that direction."

7. "As a whole, I think the department is quite thorough as far as instruction goes, but I would like to see the standard, or should I say level, raised. In other words, 'go toward the engineering side' a bit more—this you probably had already begun to gather and I think that is probably what you have in mind, glancing through the new schedule."

8. "I feel that the four-year course should be aimed at providing technicians or engineers for the automotive industry, rather than super trained mechanics for the garages. The two-year course will provide the mechanics. In order for the student to get his money's worth from the four-year course he should be provided with a degree in automotive engineering. Many schools, do it, why not the A.C.? After a year in industry I was very disappointed in what I have received from a four-year college course in comparison to what other men had received from theirs.

I had to go to night school to keep up."

9. "I feel, that this course is ideal for people who wish to enter the automotive field as mechanics and shop foremen or become instructors in automotive. However, I have always regretted that I did not work for a Mechanical Engineer Degree."

10. "A good many graduates are competing with engineering students for jobs. I think this field should be changed into an engineering course. Everything that is being taught here can be learned in a good trade school.

11. "If you are interested in helping the student--change to give a teachers certificate or a degree in engineering, so that students can go out and be qualified for a job."

APPENDIX B

Utah State Agricultural College
Automotive Technology Department
Logan, Utah

February 7, 1955

Dear Fellow Graduate:

I am attempting to get an evaluation of the automotive training program here at the Utah State Agricultural College. To evaluate the program properly I am writing to everyone that I can possibly contact who have graduated from the Automotive Department since June of 1950.

Enclosed with this letter is a questionnaire which I would appreciate your filling out and returning to me as soon as possible. Along with the questionnaire you will find a copy of our present curriculum. You might wish to compare it with the curriculum you followed while here at the college. You will probably notice that some of the classes have been changed and some new classes added. This has been done to allow our students to get more upper division credits.

I hope to use the results of this evaluation in my thesis toward a Master's Degree which I should like to have completed by May of this year.

The success of this evaluation depends on your prompt response. Your comments and criticisms on the questionnaire will also be greatly appreciated. A self-addressed return envelope is enclosed for your convenience.

Yours very truly,

Ivan E. Lee

Enclosures 3

QUESTIONNAIRE

1. Do you feel that the classes you completed while in college were instrumental in leading you to your present job?

   Yes_____ No_____ Comment:

2. From your experience do you feel there are classes that should be added to the curriculum that will be of greater advantage to future graduates?

   Yes_____ No_____ Comments:

   If answer is yes, please list suggested classes.

   _____

   _____

   _____

3. Are there subjects in the curriculum that you feel are totally unnecessary?

   Yes_____ No_____

   If answer is yes, please list subjects.

   _____

   _____

   _____

4. What subjects in the curriculum do you feel should be strengthened?

   _____

   _____

   _____

5. What classes do you feel should be omitted, if any?

   _____

   _____

   _____

6. While you were attending U.S.A.C. did you think that the program was as up-to-date as it should be?

   Yes_____ No_____

   If answer is no, list your reasons.

   _____

   _____

   _____

7. For which of the following positions do you feel our graduates could best qualify?

   Mechanic_____

   Shop Foreman_____

   Salesman_____

   Business Manager_____

   Instructor_____

8. Additional comments:

Utah State Agricultural College
School of Engineering and Technology
Automotive Department
Logan, Utah

February 14, 1955

Dear Sir:

I am attempting to make an evaluation of the Automotive Training Program here at the Utah State Agricultural College. In order to fully evaluate the program I am writing to those schools throughout the country that offer training in the automotive field. Would someone on your staff check through the enclosed mimeographed copy of our present curriculum to help determine its suitability, practicality, and its weaknesses.

The Automotive Training Program at Utah State is possibly the only one in any school in the nation which offers a Bachelor of Science Degree in this field on a sub-engineering level. Out-of-state students, and those from other countries who come to this school, frequently do so because they know of no other school like it. I realize that these automotive offerings are actually similar to those of other schools, but it is possible that they are unique inasmuch as they are part of a regular college course. In most instances automotive training is offered as a trade program or on a mechanical engineering level.

I would appreciate very much your comments and criticisms on the enclosed questionnaire. A self-addressed envelope is enclosed for your convenience.

Very truly yours,

Ivan E. Lee, Instructor
Automotive Department

IEL:gl

Enclosures

QUESTIONNAIRE

1. Do you feel that the course material in our training program is comparable to that in your own school?

   Yes_____ No_____ Comment:

2. Are there subjects in our program that you feel should be eliminated?

   Yes_____ No_____

   If answer is yes, please list some of those subjects.

   _____

   _____

3. Are there subjects not included in our program that you feel should be added?

   Yes_____ No_____

   If answer is yes, please list some of those subjects.

   _____

   _____

4. Do you feel that our program is deserving of a Bachelor of Science Degree?

   Yes_____ No_____ Comment:

5. Do you feel that our program qualifies our students for responsible positions in industry?

   Yes_____ No_____ Comment:

6. Are there any other changes, suggestions, or improvements you feel should be made in our present program that would be of greater benefit to our students?

   _____

   _____

   _____

7. For which of the following positions do you feel our graduates could best qualify?

   Mechanic_____

   Shop Foreman_____

   Salesman_____

   Business Manager_____

   Instructor_____

8. Additional comment:

Utah State Agricultural College
School of Engineering and Technology
Automotive Department
Logan, Utah

February 14, 1955

Gentlemen:

I am attempting to get an evaluation of the automotive training program here at the Utah State Agricultural College, and I am writing to manufacturers I feel might have an interest in our graduates. Is there someone on your staff who could check through the enclosed mimeographed copy of our present curriculum to help determine its quality, suitability, practicality, and its weaknesses.

The automotive training program at Utah State is possibly the only one in any school in the nation which offers a Bachelor of Science Degree in this field on a sub-engineering level. Out-of-state students and those from other countries, who come to this school frequently do so because they know of no other school like it. I realize that these automotive offerings are actually similar to those of other schools, but it is possible that they are unique inasmuch as they are part of a regular college course. In most instances automotive training is offered as a trade program or on a mechanical engineering level.

I would appreciate very much your comments and criticisms on the enclosed questionnaire. A self-addressed envelope is enclosed for your convenience.

Very truly yours,

Ivan E. Lee, Instructor
Automotive Department

IE:gl

Enclosures

QUESTIONNAIRE

1. Does this curriculum (Training Program) appear to provide satisfactory training toward employment in your company or institution?

   Yes_____ No_____ Comment:

2. Would you consider the completion of this curriculum deserving of a Bachelor of Science Degree?

   Yes_____ No_____ Comment:

3. Do you feel there is a definite need for the type of education obtained in this curriculum?

   Yes_____ No_____ Comment:

4. In consideration of your employment needs,

   (a) What phases of the course do you think should be strengthened?

   _____

   _____

   (b) What subjects do you feel should be added?

   _____

   _____

   (c) Which subjects do you feel are unnecessary?

   _____

   _____

   (d) Would you welcome applications for employment from our automotive graduates?

   Yes_____ No_____ Comment:

5. For which of the following positions do you feel our students seem best qualified:

   Mechanic_____

   Shop Foreman_____

   Salesman_____

   Business Manager_____

   Instructor_____

6. Additional Comment:

AUTOMOTIVE TECHNOLOGY

Owen Slaugh, Assistant Professor, Head of Department; Lynn Willey, Vern R. Beecher, Assistant Professors; Clyde Hurst, Ivan E. Lee, instructors.

This department offers a Bachelor of Science Degree in Industrial Technology with majors in Automotive Technology, Auto Body Reconditioning, or Diesel Technology. It also provides general service courses for students in other departments who desire to become familiar with various phases of automobile education. In cooperation with the Industrial Education Department courses are offered in Driver Education.

Training facilities include a new building designed and built specifically for automotive and aircraft instruction. The laboratories contain the most modern servicing and testing equipment, and provide ideal conditions for study.

A major in Automotive, Diesel, or Auto Body Technology prepares a student to be a technician who can better interpret the designs of the engineers and direct the work of repairmen. This major also prepares students to become shop foremen, shop superintendents, and with special preparation, school instructors. Excellent background is provided for entrance into civil service, private business, and managerial positions with large companies.

Students desiring to more thoroughly prepare themselves for advanced or graduate study in Automotive or related engineering may do so by substituting mathematics and engineering courses during their junior and senior years.

CURRICULUM

Degree: Bachelor of Science in Industrial Technology
Major: Automotive Technology

Freshman

Course	F	W	S
Auto 1, 2, 3	6	6	6
Math. 34*, 35, 44	3	5	3
English 17, 18, 19	3	3	3
E. D. 61, 62, 93	3	3	3
C. E. 65			1
M.S. 1, 2, 3	1	1	1
	16	16	17

Sophomore

Course	F	W	S
Auto 4, 5, 6	6	6	6
Physics 17, 18, 19	5	5	5
Weld. 91, 94		3	3
T. E. 51		3	
E. E. 21	4		
Auto 54			3
M. S. or A. S.	1	1	1
	16	18	18

* Students who have completed high school Algebra B and who make satisfactory grades on the mathematics entrance examination may omit Math 34 and begin with Math. 35 Fall Quarter.

Junior				Senior			
Course	F	W	S	Course	F	W	S
Auto. 101, 102, 103	3	3	3	Auto 151, 152, 154	3	3	3
Auto. 61, 162	3	3		P. H. 155 or Zoo. 111		3(4)	
Econ. 51	5			Econ. 125	3		
Chem. 10, 11	5	5		Aero. 131		3	
Weld. 190		3		I. E. 113			3
C. E. 176			4	B. A. 109, 147, 148	3	3	3
English 112			4	T. E. 150			3
I. E. 120 Psy. 155	2	3	3	A. E. 82	2		
Electives	2	3	3	Chem. 125	5		
	18	17	17	Electives		5	5
					16	17	17

DIESEL TECHNOLOGY MAJOR

Substitute Auto. 21, 22, 23, 121, 122, and 123 for Auto. 1, 2, 3, 101, 102, 103.

AUTO BODY RECONDITIONING MAJOR

Substitute Auto 52, 53, for Auto 2; Auto 12, 13, and 16 for Auto 4, 5, 6; and Auto 113 for Auto 102. Interchange E. D. 62 and 93 with Weld. 91 and 94.

Certificate of completion in Automotive Repair, Diesel and H. D. Mechanics, and Auto Body Reconditioning will be granted upon application and payment of diploma fee to students completing the Freshman and Sophomore years of the respective curriculum.

COURSES

Freshman Year

1. Steering Correction. (Technical and Shop) Construction, operation, and repair of all parts of the automobile chassis. Units studied are axles, wheels, control linkage, wheel suspension, steering gears, wheel alignment, and hydraulic brakes. Modern methods of repair. (6F)

Beecher

2. Automotive Engines. (Technical and Shop) Construction, operation, and repair of the modern automobile engine, including cylinder blocks, piston assemblies, crankshaft assemblies, valve assemblies, cooling and lubricating systems, Modern Methods of repair. (6W)

Lee

3. Driving Mechanisms. (Technical and Shop) Construction, operation, and repair of clutches, transmissions, overdrives, universal joints, drive shafts, differentials and rear axles. Modern methods of repair. (6S) Beecher

34. Introduction to College Algebra. Prerequisite: one year of high school algebra; Students who have had more than one year of high school algebra are not given college credit for mathematics 34. Daily. (3F, W or S)

35. College Algebra. Prerequisite: 34. (5F, W or S)

44. Plane Trigonometry. Prerequisite: 35. (3F, W or S)

17, 18, 19. Freshman English. For Forestry, Engineering, and Technology students only; drill in fundamentals of sentence and paragraph structure. Exercises in grammar, vocabulary, and spelling. Composition, with stress on intelligent thinking and clear expression. (3F, 3W, 3S) Staff

61, 62. Engineering Drawing. The use of drafting instruments, graphic solutions, applied geometry, lettering, principles of shape and size description, sectioning, and standard elements and symbols. Problems are included in sketching; pictorial illustrations are made from orthographic views. (3F, W, S) Staff

93. Mechanical Drawing. Advanced work for those interested in a drafting minor. Includes basic work in industrial drawing, including machine fasteners, developments for patterns, and fundamentals of architectural, structural, welding, piping, and electrical drawings. Prerequisite: E. D. 62 (3F, S) Preator; Loveless

65. Engineering Problems. Methods of computations include the use of logarithms, slide-rule, and calculating machines. Emphasis is placed upon the development of good habits of work and study. Prerequisite: Math. 35. One lab. (1F or 1S) Tingey

1, 2, 3. Military Science.

Sophomore Year

4. Fuel Systems. (Technical and Shop). Construction, operation, and repair of gasoline tanks, fuel systems, carburetors, manifolds, controls and such special devices as superchargers, governors, and auto diesel engine fuel systems. Modern methods of repair. (6F) Slaugh

5. Auto Electrics. (Technical and Shop.) Construction, operation, and repair of electric systems used on modern automotive equipment, including the battery, lighting systems, ignition systems, starting and generating systems. Modern methods of repair. (6W)
Beecher

6. Motor Tune-up. (Technical and Shop). Correlates the work covered on engines, carburetion and electrics. Tests for troubles are made with modern tune-up equipment; these troubles remedied by trade-accepted methods. Prerequisites Auto 2, 4, 5. (6S)
Slaugh; Beecher

17, 18, 19. Mechanics and Molecular Physics. Electricity and Magnetism. Heat, Sound and Light. For Science majors and Engineers. Prerequisite: Math 44 or 46. Should be taken in sophomore year, and in the sequence indicated, except with permission of instructor. Three lectures, two labs and two quiz periods per week. (5F, 5W, 5S)
Jensen

91. Acetylene Welding. Principles and practice in fundamentals of oxy-acetylene welding and cutting. A general service course open to all college students. Two lectures, two 2 hour labs. (3F, W or S)
Child

94. Electric Welding. Principles and Practice in use of the latest types of electric-arc welding equipment. Safety measures and methods used in arc-welding of steels. Two lectures, two 2-hour labs. (3F, W or S) Child

51, 52. Machine Tool Operation. Training in use of hand tools, and in bench work and tool sharpening, together with elementary training on drill press and engine lathe. Reading assignments on machine tool operations, and applications of mathematics to machine tool problems are included. (5F, W or S) Somers

21. Fundamentals of Electricity. A service course for students in Industrial Arts, Automotive, Welding, etc. Basic principles of practical and applied electricity; DC and AC circuits; power, wire and wiring; motor, generator and transformer principles; batteries; meters. Prerequisites: Math. 34 or equivalent. Three lectures, one demonstration lab. (4F, 4W, 4S) Staff

54. Service Techniques. Theory and practice in service station and shop management records. Professional ethics. Selling and installing automobile accessories. Minor repairs and lubrication. (3W, S)

Military Science or Air Science

Junior Year

101. Frame Suspension and Steering Systems. (Technical and Shop). Geometry and design factors of the various types of steering units including power steering, wheel balancing, frame alignment, and power brakes are studied in relationship to steering facility. Prerequisite: Auto 1, Math. 34, 44. (3W) Beecher

102. Internal Combustion Engines. (Technical and Shop) Design and operational characteristics of different engine types. Attention is given such items as combustion chamber design, precision cylinder and bearing boring, engine balancing, valve actuating mechanisms, determination of bearing loads, inertia and centrifugal forces and production of engine parts. Prerequisite: Auto 2, Math. 35, 44. (3W) Staff

103. Automatic Transmissions. (Technical and Shop). Development of fluid couplings, torque convertors, automatic transmissions, electric clutches, and hydraulic valve control systems. Tests and trouble diagnosis procedures emphasized. Prerequisite: Auto 3. (3W) Beecher

61. Body and Fender Repair. Principles and practice in fundamentals of fender and body repairing, including work in metal finishing, light welding, door and body alignment. Open to any college student. Two lectures, two 2-hour labs. (3F, S) Willey

162. Metal Refinishing. Principles and practice in preparing metal for refinishing. Fundamental procedures in priming, surfacing, and applying lacquer, enamel, and other special finishes. Two lectures, two hour labs. (3F, 3W) Willey.

51. General Economics. For the general college student regardless of field of specialization. Emphasis is on understanding of principles and institutions underlying operations of the economic system. (5F, W or S) Staff

10, 11, 12. General Chemistry. Fundamental principles of inorganic and organic chemistry. A one-year terminal course open to any matriculated student. Students with a grade of B or higher may enter Chemistry 5 in the spring quarter. (5F, 5W, 5S) Staff

190. Advanced Acetylene Welding. Vertical and overhead steel welding. Special problems. Prerequisite: 90. (3F, 3W, 3S) Child

176. Application of Thermodynamics. For Air Conditioning, Aeronautic, and Automotive majors. Applications of laws of thermodynamics to combustion engines, compressors, vapor cycles, and refrigeration are studied. Prerequisites: Math. 35, 44; Physics 22. Three lectures. (3S) Dionne

112. Advanced Writing Problems. A practical course in special problems of writing, such as letters of application, summary abstracts, short reports, and informal articles; mainly for juniors and seniors in forestry or engineering who do not take 111. (4F, W or S) Anderson; Keck

120. Personnel Relations. Training for leadership in industry as foremen, supervisors, and directors. Problems in organizing, supervising, training, and directing personnel. Directed conferences based on student experiences and directed studies in leadership problems and principles. Three lectures. (3F, W or S) McBride

Senior Year

151. Carburetion. Technical training in fuels and combustion processes related to internal combustion engines. Emphasis is given to cycle analysis and associated carburetor problems affecting combustion. Prerequisite: Auto. 52 or equivalent. Two lectures, one 3 hour lab. (3F) Slaugh

152. Motors, Generators, and Magnetos. Technical training in construction and operation of electrical testing equipment used with the major electrical units of the automobile. Emphasis is given in industrial testing procedures and practices. Principles and practices in construction, operation, and repair of magnetos. Prerequisite: Auto 53 or equivalent. Two lectures, one 3 hour lab. (3W) Beecher

154. Seminar and Special Problems. A systematic review of the automotive field with discussions and reports on recent developments. Lab. analysis of special problems encountered in automotive work. Prerequisites: Auto 151 and 152. Two lectures, two 2 hour labs. (3S) Slaugh

155. School Health. Health Training for state certification requirements in health education. Three lectures. (3F, W. S, Su) Smith, Stevens

125. Trade-Unionism and Collective Bargaining. Development, structure, function, government, and philosophy of trade unions in United States; making and administering collective agreements; impact upon the system; policy issues. (3F)

131. Time and Motion Study. Techniques of time and motion s tudy and their inter-relationships. Detailed discussion and practices with process charts, multiple-activity charts, micromotion study. Therblig check list, motion economy and stop-watch time study. Methods of application and personnel problems involved. (2W)
Klein

113. Driver Education and Traffic Safety. To acquaint prospective teachers and others with available instructional materials for driver education and the latest methods of presenting these materials in the classroom and on the road. Supervised practice is arranged for each student. (3F, W or S) Beecher

109. Accounting for Non-Commercial students. For Engineering, Agriculture, Home Economics, Forestry, and other non-commercial students. (3F, W) Gardner, Cannon

147, 148. Administration of Small Business. For students in Engineering, Technology and Agriculture. Attention given factors that determine whether a business should be started, form of the business; such operating problems as accounting, statistical control, financial control; and problems of marketing. (3W, 3S)
Loll

150. Metals and Heat Treatment. Physical properties, composition, constituents, and heat treatment of metals used in industry, including cast iron, wrought iron, plain carbon steel, alloy steels, brasses, bronzes, aluminum alloys and magnesium alloys. Prerequisites: Chemistry 10. Two lectures, one lab. (3F)
Preator

82. Forge Practice. Fundamental operations. Recommended for Industrial Arts, Woodworking and Building Construction students. Two labs. (2F, W or S) Wadsworth

125. Applied Organic Chemistry. Biological applications are emphasized. Designed especially for students in Agriculture, Home Economics, and Nutrition. Chemistry majors should register in Organic Chem. 121 and 122. Prerequisite Chem. 5 or 11. (5F, 5W)
Burton

DIESEL TECHNOLOGY MAJOR

21. Heavy Duty Chassis. (Technical and Shop). Construction, operation, and repair of automotive diesel and heavy-duty chassis. Units covered are heavy duty axles, wheels, control linkage, wheel suspensions, steering gears, wheel alignment, frame straightening, and brakes. (6F) Hurst

22. Automotive Diesel Engines. (Technical and Shop) Construction, operation, and repair of automotive diesel engines, including two-stroke cycle and four-stroke automotive, truck and tractor engines and their accessories. (6W) Hurst

121. Power Steering and Power Brakes. Functional characteristics and servicing of intricate steering and brake devices used on heavy vehicles. Includes differential brake steering and hydraulic controls. Prerequisite: Auto 21 (3W) Hurst

122. Fuel Injection Systems. (Technical and Shop) Design, operation and servicing of diesel and gasoline injection systems. Includes air and solid types injection. Turbulence requirements of induction are considered. Prerequisite: Auto 22, Physics 19. (3W) Hurst

123. Hydraulic Drives and Special Differentials: A study of history and development of hydraulic clutches and transmissions used on trucks and buses. Consideration is given to unique gear designs, strength tests of materials, torque arms, radius rods, angular drives, and the evolution of differential gear design. (3S) Hurst

AUTO BODY RECONDITIONING MAJOR

52. Automobile Power Plants. Principles and practice in construction, operation and servicing of the modern automobile power plant. Units of the course include cylinder block assemblies, piston assemblies, crankshaft assemblies, valve assemblies, clutches, transmission, overdrive, fuel, cooling and lubrication systems. Open to any college student. Two lectures, two 2-hour labs. (3F, W, S) Lee

53. Automobile Electricity. Principles and practice in the construction, operation, and servicing of electrical systems used on modern automobiles. Units studied include starting, generating, lighting, ignition, and special accessory systems. Open to any college student. Two lectures, two 2-hour labs. (3S) Hurst

12. Fender Reconditioning. (Technical and Shop) Roughing out, shrinking, leading, buffing, sanding, and metal finishing of fenders. General use of the spray gun in applying primer surfaces. (6F) Willey

13. Body Reconditioning. (Technical and Shop) Construction and repair of automobile bodies. Units include checking and alignment of automobile bodies and repair and replacement of damaged body panels such as the dash, cowl, trunk, rocker, floor, side, top and door panels. Prerequisite: Auto 12 (6W) Willey

16. Automotive Refinishing. (Technical and Shop) Preparation of body metal and application of lacquer and synthetic enamels, including metal preparation, priming, surfacing, and application of color. Practice in spotting, striping, and graining. (6S) Willey

113. Body Mechanisms (Technical and Shop). Modern mechanical, electrical, and hydraulic body regulating devices, windshield wipers, body wiring, heaters, and lights. Includes radio replacement. Prerequisite Auto 13. (3W) Willey