Profile of . . .

ENGINEERING MECHANICS

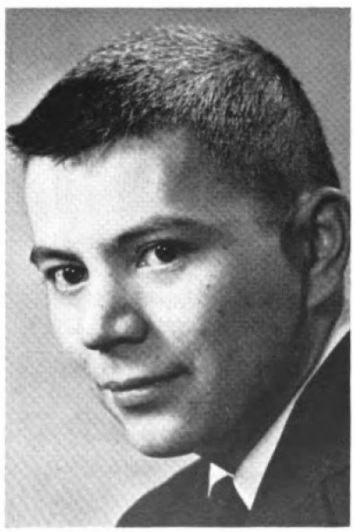
by FRANCIS FAY, '60E

Engineers were once described by a man now in industry as those men who knew that: "F = m times a and that you can't push on a rope!" As humorous as this description is, however, it is true that forces *do* play an important part in every engineer's life. Not only are there mechanical forces, but also electrical forces. Then too, the effects of forces on structures and in fluids are studied by some engineers. Thus, forces have been interwoven into every branch of the engineering profession, and mechanics, the field of science which deals specifically with forces, can be seen to be basic to all of them.

Mechanics has always been an essential part of engineering curricula at the University of Michigan. Prior to 1911, the basic courses in mechanics at the University were taught by two departments. Courses in dynamics were offered by the Department of Physics and Mathematics, while the Department of Civil Engineering offered instruction in strength of materials. This arrangement, however, proved to be unsatisfactory. At the turn of the century, engineering fields other than civil became interested in advanced studies in mechanics. Furthermore, these new interests were in areas such as dynamic loading, resilience, and stress concentrations, which were of little importance to the departments of Civil Engineering, and Physics and Mathematics. Therefore a change was imminent, for this educational system had to be revamped to serve the new interest in mechanics.

In 1911, the Department of Engineering Mechanics was established at the University. The department was to offer the elementary or basic courses in mechanics, which were common to all enginering curriculums. The objectives of this change were threefold. First, the elementary courses were to be of such a nature that any type of subsequent or advanced work could conveniently be pursued. Secondly, these courses could also serve as complete instruction for those curriculums which only require a general background in mechanics. Finally, the new program would permit instructors in the Departments of Civil Engineering, and Physics and Mathematics to devote more time to advanced studies in their particular fields. Beyond these objectives, moreover, there was a provision for advanced courses. Any department could request special mechanics courses to be offered by the Department of Engineering Mechanics.

Since 1911, the Department of Engineering Mechanics has grown steadily. Today the department not only has a comprehensive group of courses in engineering mechanics, but also has both undergraduate and graduate degree programs.



Engineering mechanics comes easy to Francis Fay, the author of this article, as he is presently enrolled in that department of the College. In addition, he worked for about eight months on the Redstone missile as an aide in the dynamics testing section of Crysler.

Now a junior, Francis comes from Rochester, N. Y., where he was quite active in high school sports. He is a member of the social fraternity, Alpha Delta Phi, and is now married and has one child.

Three Areas of Department

The scope of engineering mechanics is very broad. To gain an idea of what engineering mechanics is, it is convenient to arbitrarily divide the field into three areas—statics and dynamics, strength of materials, and fluid mechanics. Beyond these definitions a better understanding can be gained through illustrations of industrial applications.

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Statics and dynamics are fundamental to all studies in engineering mechanics, but they are also quite wide in their scope. Statics concerns itself with the effects of forces on bodies in equilibrium. Dynamics, on the other hand, is the study of bodies in motion, and consists of two separate fields—kinematics and kinetics. Kinematics is the study of motion without consideration of forces, while kinetics encompasses both forces and motion. The relationships of dynamics are essential to the guidance and control of ballistic misssiles, for the trajectory of a missile is determined from the kinetic relationships and the controls depend upon the effect of forces on the vehicle.

Strength of materials is the study of the effects of forces on engineering materials, and the use of resulting relationships for engineering applications. Elementary courses in this area deal with problems of elastic stress and strain arising from the application of forces to structures. Advanced courses encompass the plasticity of materials, and it is the plastic deformation of materials that is becoming more important to engineers. For example, the nose-cone of the Redstone missile is designed in the plastic range so that it deforms while re-entering the earth's atmosphere, but will still deliver its payload. By designing in the plastic range a considerable weight reduction is possible.

Fluid mechanics deals with the properties of fluids, both compressible and incompressible, and concerns itself with such factors as force, energy, and viscosity. Supersonic flight and rocket propulsion are some of the areas of advanced study in this field, and some important applications are in the field of pneumatic and hydraulic servo-mechanisms (i.e., controlling device) used in missiles. Servo-mechanisms are used to control such important functions as fuel mixing and guidance manipulations.

Present Curriculum

The current program leading to a degree of Bachelor of Science in Engineering (Engineering Mechanics) is designed to prepare the student to integrate the science of mechanics with engineering applications.

Like all engineering students at the University, the engineering mechanics student must fulfill the requirements of professional subjects, and can do so under either the "traditional" or the "science" engineering sequence. These courses include basic instruction in English, math, physics and chemistry. The English courses develop the student's ability to communicate both in writing and in speech, and they also stimulate his interest in literature. Mathematics, the most fundamental engineering subject, will, if mastered, aid immeasurably in the student's subsequent work. Survey courses in physics and chemistry familiarize the student with two sciences which have made great contributions to engineering and are in themselves engineering specialties. Collectively these professional subjects comprise approximately 35% (ie., 44-53 credit hours) of an engineer's academic work.

For his foundation in mechanics, the engineering mechanics student is required to take advanced courses in both engineering mechanics and mathematics. The math requirement is necessary because of its use in the treatment of advanced engineering mechanics courses. At least nine credit hours of math are required beyond sophomore year calculus. The engineering mechanics requirements can include subjects such as the theory of plasticity, vibration analysis or the mechanics of inviscid fluids, and together with the math requirements give the student a specialized background, which also comprise about 35% (i.e., 42 credit hours) of his academic work.

The remainder of the program is composed of miscellaneous subjects, such as economics and non-technical electives, and a sequence in one of twelve other engineering programs, such as aerodynamics, electronics, hydraulics, instrumentation and structures. This minor field forms an area of application for the student's special background in mechanics, and in this field he is better prepared to handle a special problem involving mechanics than the engineer who was trained for the field.

Opportunities For E.M. Students

The engineering mechanics student with a bachelor's degree is as suited for graduate work as any other type of engineer, and he can profitably continue his academic work to the master's or doctor's level.

With a bachelor's, master's or doctor's degree the engineering mechanics graduate is probably best suited for research and development. This is to his advantage, for civilian industry is emphasizing more and more research and development for new and better products, while national defense spending is also creating a critical shortage of such engineers. Progressive corporations and defense industries are increasing their specific requests for engineering mechanics graduates.

Not only is mechanics becoming more necessary to old engineering functions, but new fields are developing which can best be filled by engineering mechanics graduates. The age of airplanes and missiles requires careful application of mechanics to minimize overdesign and increase reliability. Topics such as vibration engineering present needs which can best be filled by the engineering mechanics graduate. The increasing complexity of the technical world foreshadows the continued growth of engineering mechanics, and the continued demand for engineering mechanics graduates.

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IN THE APRIL ISSUE

Engineer's Weekend—a special report on a coming event when the engineers take over the campus.

Transistors—What are they used for? Who uses them? Just what are transistors?

Instrument Landing Systems—the modern method of guiding aircraft into terminals without mishaps.

George Granger Brown — Students, faculty, and administration honor the late dean of the College.