SUMMER INSTITUTE FOR ENGINEERING AND TECHNOLOGY EDUCATION

MECHANICAL ENGINEERING

INTRODUCTION TO MECHANICAL ENGINEERING

CONCEPT

This module discusses some of the details related to the field of Mechanical Engineering.

OBJECTIVES

To expose the readers to the type of work Mechanical Engineers perform. To give the readers an idea about the courses required to pursue a degree in Mechanical Engineering. To describe the career opportunities available to Mechanical Engineers.

INTRODUCTION

Mechanical Engineering primarily involves man made devices. Machines, power systems, factory production lines, boilers and pressures vessels, and automobiles are some of the devices Mechanical Engineers design, build and improve. Mechanical Engineering is the second largest engineering profession (behind Electrical Engineering).

HISTORY

Mechanical Engineering is one of the oldest engineering professions (Civil Engineering is the oldest of all). Mechanical Engineering can trace its roots back to the very beginning of the Industrial Revolution, from 1750 to 1800 in Europe and 1800 to 1850 in the United States. The invention of the steam engine by James Watt in 1802, propelled the growth in this field by leaps and bounds. After the invention of the automobile, both the need for precisely machined metal and a more formalized method of assembling the components.

THE JOB

In the past, a Mechanical Engineer might sit at a drafting table calculating the dimensions of a piece of equipment. A machine shop, would in turn cut and ground the metal to form the prototypes of the actual parts. Today, much of the design work is done using a computer with specialized programs called the CAD (Computer Aided Design). The vision of the future includes developing designs on a computer, testing them with other programs, and then sending the designs to automated production machinery that will fabricate and assemble the parts.

A list of the different fields in which Mechanical Engineers work are:

- *Basic Engineering,* including fluids, applied mechanics, heat transfer, tribology (the study of lubrication), and Bioengineering.

- *General Engineering,* covering management, safety, and technology and society.
- *Manufacturing,* involving materials handling, production engineering, textile engineering, process industries, and plant engineering and maintenance.
- *Energy Conversion,* including fuels and combustion technologies, internal combustion engines, power and nuclear engineering.
- *Materials and Structures,* comprising materials, pressure vessels and piping, offshore mechanics and Arctic Engineering.
- *Energy Resources,* involving petroleum, solar energy, ocean engineering, and advanced energy systems.
- *Environment and transportation,* covering the topics of rail, aerospace, environmental control, solid waste processing, noise control and acoustics.

Some typical job titles are:

- *Design Engineer:* These engineers work with computer programs, laboratory models, and prototypes to develop new machinery or components or to improve.
- *Manufacturing/Production Engineer:* These engineers are responsible for keeping the production lines, power plants, and other assembly lines running smoothly. They concentrate on coordinating various stages of a manufacturing process to achieve optimum output.
- *Maintenance Engineer:* Maintenance engineers work with mechanics and technicians to put a faulty machine back into operation. In addition, the maintenance engineer looks at why a machine is failing.
- *Reliability and Testing Engineer:* Long term performance is a key characteristic of well built machines. These engineers develop testing methods and review processes to determine how well equipment stands up to use.

EDUCATION

Mechanical Engineers require a strong background in science and math. Accordingly, interested students are encouraged to take high school courses in math, physics, chemistry and computer programming. In college in addition to taking more courses in these areas, there are other specialized courses such as:

- *statics, dynamics and kinematics* - the study of forces and motions.
- *control theory* - the study of computer controlled mechanical devices such as anti lock brakes.
- *thermodynamics*- the study of energy conversion.
- *mechanical design*- the study of turning an idea into a product.
- *computer systems*- the study of computers to aid the Mechanical Engineer.
- *metallurgy*- the study of material properties to improve product performance.

CAREER OPTIONS

Mechanical Engineers can choose from a wide range of career options. Private industries which employ them include the automobile industry, aircraft, power plants, and amusement parks. In

the public sector, the defense industry is the predominant employer of Mechanical Engineers. In addition, Private companies, public sectors, and universities offer a wide range of research opportunities.

SALARIES AND THE INTANGIBLE REWARDS

Here's the good news. Engineering graduates enter the work force and earn the highest pay of any college graduates. From there, salaries level off but are still very high relative to other professionals.

BIBLIOGRAPHY

BASTA, NICHOLAS, *Opportunities in Engineering Careers,* Nicholas Basta, VGM Career Horizons, Lincolnwood, IL 60646.1990

NORBACK, CRAIG T., *VGM'S handbook of scientific & technical careers,* VGM Career Horizons, Lincolnwood, IL 60646. 1990

PROFESSIONAL ORGANIZATIONS

The American Society of Mechanical Engineers (ASME)

22 Law Drive,
P.O. Box 2900
Fairfield, NJ 07007-2900
Phone #: (201)-882-1167
1-800-THE-ASME
e-mail: infocentral@asme.org

The Engineering Society for Advancing Mobility Land Sea Air and Space (SAE)
400 Commonwealth Drive,
Warrendale, PA
15096-0001

OTHER RESOURCES

Books:

Job Choices... in Science & Engineering, College Placement Council, Bethlehem, PA. 1990

Peterson's guide to engineering, science, and computer jobs, Princeton, NJ, 1990

Videotapes:

Engineering is for Everyone! Audience: Grades K-6, Order Number: VX0191, ISBN: 0-7918-0105-5, Price: $19.95

Career Encounters: Mechanical Engineering, Audience: Grades 9-12, Order Number: VHS190, ISBN: 0-7918-0114-4, Price: $ 90.00

It's Not Too Late Power Engineers, Audience Grades 6-12, Order Number:VHO192, Price: $23.00

Career Encounters: Women in Engineering, Audience: Primary, Precollege and College age Females. Order Number: VBMW94, Price $19.95

For more information on the Videotapes contact:

ASME Public Information Department,
American Society of Mechanical Engineers,
345 East 47 th Street
New York, NY 10017
Telephone #: (212)-705-7740
Fax #: (212)-705-7143
e-mail: infocentral@asme.org

A World In Motion

This is a fully integrated print and video program sponsored by SAE. This organization of engineers is dedicated to advancing mobility on land, in sea, air and space. *A world in motion* is a part of Vision 2000, SAE's overall effort to help improve science education. This program emphasizes hands on discovery of science principles in a cooperative learning setting.

Grades: 4 to 6

Components:

- 15 teacher directed learning cards.
- A Teacher's guide complete with concept scope and sequence charts, science background information, and helpful teaching suggestions
- Materials, a booklet of material lists, hints, and other information about materials.

For more information about Registration/Order Form contact:

SAE international, A world in motion
400 Commonwealth Drive
Pittsburgh, PA 15096-0001
FAX 412-776-2013

Possible Field Trips

- Plastic extrusion plant
- Manufacturing Plant
- CAD/CAM work station

Possible Experiments:

Internal Combustion Engine:

Nearly all internal combustion engines in vehicles today, are reciprocating type engines. These engines are based on piston-cylinder chamber. A model of a reciprocating engine can

be built using two empty soup cans for piston and cylinder, "foam board" for the slider crank linkages, and screw posts for the hinges to connect the links of the crank-slider. Use a large section of the foam board as a "platform" to mount the mechanism. Provide additional supplies such as glue, rubber bands, scissors etc. and let the students design the model. The students will get first hand experience in designing the model using the available tools. In addition, numerous areas of mechanical engineering can be explored.

Global Circulations of Oceans and Atmospheres

This experiment is designed to show the cause and effect of global circulation in the earth's oceans, atmosphere, and within the earth's core. The primary cause of ocean currents and wind is usually ascribed to uneven heating. Due to this uneven heating there is a change in the density of the fluids. The fluid, either air, water or molten rock, changes density when its temperature changes. The change in density is caused by the change in Kinetic energy of the individual molecules. The molecules become widely spaced as their velocity and momentum exchange with neighboring molecules becomes greater.

To demonstrate this effect an aquarium filled with colored water is used. We use a short section of heating tape under the center of the tank as our heat source. To be able to see the fluid move we use a particle tracer which is slightly more dense than the water and is distributed along the bottom of the tank. The experiment begins by turning on the current to the heating tape under a still tank. Initially there is a disturbance directly above the tape but no circulation. After some time, the entire tank becomes involved with the circulation and a model of circulation is complete.

Contact Angles

Liquid bubbles on a horizontal surface develop different shapes because of the liquids affinity to the surface. The angle between the liquid vapor interface and the solid surface, measured through the liquid vapor interface and the solid surface, measured through the liquid is called the contact angle. Glass and metals are considered "high energy surfaces, while plastics, polymers, and hydrocarbons are low energy surfaces. When a water droplet is placed on a high energy surface (like copper of glass) a small contact angle is formed and the bubble spreads out. Furthermore, when a water droplet is placed on a low energy surface (like Teflon), a high contact angle is formed and the bubble is not in contact with as much of the surface.

Heat transfer equipment typically attempts to transfer heat energy through a metal surface into a fluid. If the fluid is in the form of liquid bubbles, then a small contact angle is desired so that each bubble will be in contact with more of the solid's surface and will be able to pick up more heat from the surface. On the other hand , a more recent product on the market is one that will increase the contact angle for rainwater bubbles that gather on an automobile's windshield. A thin layer of the liquid product is spread on he windshield converting the glass from a high energy to low energy surface. As the rain water gathers on the glass, the wind pushes it off of the windshield because the bubble has a high contact angle and very little surface touching the glass. Therefore windshield wipers are not needed except for heavy rainfall.

The students can see how water bubbles from on the glass, copper, Teflon (or paraffin) and their own skin, while viewing the contact angles with magnifying glass. After that they should spread a layer of Rain-X onto one half of a piece of glass and see how the contact angle compares to a bubble placed on the uncoated half.