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Fostering curiosity, discovery and innovation to benefit society.

¹What are technology and engineering?

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TECHNOLOGY MODIFIES THE NATURAL WORLD through innovative processes, systems, structures and devices to extend human abilities. Engineering is design under constraint that develops and applies technology to satisfy human needs and wants. Technology and engineering, coupled with knowledge and methods derived from science and mathematics, create social and environmental value and economic wealth to improve the quality of life. These short definitions of technology and engineering provide a framework to understand the interdependent relationship between science, technology, engineering and mathematics.

Engineering enhances technology and technology defines civilization. Civilization has passed through the Stone Age, the Copper, Bronze, and Iron Ages, and the Industrial Age; now we are in the Information Age. The unmistakable trend is from materials to processes with information as the new material to be shaped, formed and used in products and services with social, environmental and economic benefits.

However, modern technology is not simply about information and computers. Technology includes agriculture, aviation and aerospace, construction, energy and power, environment and natural resources, information and communications, materials, medicine and health, and transportation. Broadly speaking, technology and engineering include all of the many mechanical, electrical, and chemical disciplines. However, they are much more than that.

CREATIVITY, INNOVATION AND DESIGN are at the heart of technology and engineering. Creativity is not the exclusive domain of arts and humanities. Creativity is the imagination that provides new concepts, ideas or ways of looking at the world that engineering can use to meet needs or wants. Creativity is necessary in the fields of technology and engineering within the limits of fundamental technical, scientific and mathematical knowledge and principles.

Creativity benefits engineering by unleashing the bounds of traditional thought. Innovation generates and applies creative ideas to technology through engineering solutions that have practical value in the marketplace and more broadly in social structures such as organizations including business, industry, government and education.

Technology and engineering solve problems within scientific and mathematical limits or constraints. Scientific inquiry (1) identifies a problem or question and (2) proposes a hypothesis that might offer a solution to the problem or answer the question. Similarly, technological and engineering design projects require (1) a problem or needs statement and (2) a design statement that identifies limiting factors and criteria for success. These limits might include cost or affordability; reliability, material limits (strength, weight, resistance to corrosion, color, surface texture, ease of manufacture or reproducibility), operating environment or conditions (temperature, humidity, barometric pressure, caustic conditions); ergonomics (human factors), health, safety and environmental concerns; and general ease of use or operation.

Like the methods used to test a scientific hypothesis, technological and engineering design projects must test the “design statement” to see, for example, how close a prototype meets design criteria. Generally, the results of an engineering and technological design project will describe the extent to which the prototype meets the design criteria. Scientific inquiry states the extent to which the results derived from experimentation validate or invalidate a hypothesis. Thus, a hypothesis is to inquiry as design is to engineering and technology. With science, technology and engineering, the results of repeated trials are important to validate or invalidate the hypothesis, or design.

SCIENCE DEALS WITH HUMANS’ UNDERSTANDING of the real world about them—the inherent properties of space, matter, energy, time and their interactions. Engineering deals with the application of objective knowledge to the creation of plans, designs, and means for achieving desired objectives. Mathematics defines relationships and contributes logic to problem-solving. Engineering uses tools and techniques to carry out those plans.

Science tests and validates our understanding of nature, while engineering turns this understanding into new machines, processes, and technologies. Engineering consists of thinking and planning about nature and existing materials or products – about how they can be altered and improved to achieve objectives that benefit humankind by “designing under constraint”, where the constraints include the laws of nature, cost, safety, reliability, environmental impact, manufacturability, and other factors. While engineering requires the application of mathematical and scientific knowledge, it is the design process and the practical nature of the solutions that best distinguish this field.

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