

Curriculum Guide
Program Area: Engineering

STANDARD 1.0 – DEVELOP AN UNDERSTANDING OF ENGINEERING PROBLEM SOLVING AND DESIGN PRACTICES					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
1.1	Identify the steps of the scientific process	Basic step of the scientific process (5 steps) State the problem/question Form a hypotheses Analyze data State conclusion Communicate results	Scientific term for depended variable ordinate What process starts with a question about an observation scientific question	Ordinate Analyze Scientific Process Observation	X
1.2	Differentiate between the use of the scientific method by scientists to validate theories and by engineers to solve problems	Difference between scientific method and engineering process scientific methods is pursuit of knowledge and the engineering process is a solution to the problem	Engineering process is the term for devising a system component or process to meet a desired need Brainstorm solutions	Validate Engineering Process Scientific Process	X
			Engineering design cycle steps (generic) Define problem Select best solution Develop solution Test solution Improve solution		

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1.3	Define the role of iteration in engineering practices	Define the role of iteration in engineering practices	Scientific method is iterative because it builds on previous results to validate a solution	Iteration Process Goal Interaction	X
1.4	Define the role of alternative design in engineering practices		Using a floor plan identify best location for a thermostat Brainstorming identify multiple alternatives to a problem Why aerospace engineers prefer aluminum over steel for structural elements of aircrafts. Aluminum has a higher strength-to weight ration What is a Solar water heater system? What is it made of? Define innovation and innovative activities	Brainstorming Aerospace engineers Innovative activities Innovation Research Evaluate	X
		Find the best solution to the problem considering the criteria constraints using research, brainstorming and evaluation	Decision Matrix	Criteria Constraints Decision Matrix	X
1.5	Explain how engineering includes the application of many fields of study to the problem-solving process	The interrelationship between Science, Technology, Math, and Engineering	Read 4 different kinds of graphs X-Y axis line graph X axis graph Bar Graph	Prototypes Models Evaluations Geotechnical engineer	X

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			<p>Considerations for refining gas Regulatory environment Impact in environment physical and practical limitations Cost</p> <p>The meaning of constraints in the engineering process.</p> <p>Engineers figure Safety factor of concrete materials strength to stress ratio</p> <p>Test engineer measures unit stress on a steel rod after a heavy load is applied</p> <p>Economic engineer data from surveys and experiments mean mode variance standard deviation and correlation</p>	<p>Constraints Deviation Variance Correlation</p>	
STANDARD 2.0 – APPLY CONCEPTS OF ENGINEERING PROBLEM SOLVING AND DESIGN PRACTICES					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
2.1	Apply a structured approach to solving problems including:		What is the correct order for engineering design cycle	Troubleshoot Criteria	x

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	<p>defining a problem (including customer needs), brainstorming, researching and generating ideas, identifying criteria and constraints, exploring possibilities, making a model (physical, mathematical, conceptual), evaluating the solution using standards and specifications (i.e., testing), and communicating results</p>		<p>Define problem Brainstorm solutions Select best solution Develop solution Test solution Improve solution</p> <p>In the engineering cycle what is the best approach to making improvements focus on and troubleshoot on subsystems that failed most often</p> <p>What is the step of the design process that involves evaluating the limitations identify the criteria and constraints</p>		
		<p>12 Steps</p> <ol style="list-style-type: none"> 1. Define the problem 2. Brainstorm 3. Research and generate ideas 4. Identify criteria and constraints 5. Explore possibilities 6. Select an approach 7. Develop a design proposal 8. Make a model or prototype 9. Test and evaluate using specifications 10. Refine the design 11. Create or make the solution 12. Communicate the results 			

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2.2	Define test driven design and implementation	Define test driven design method- a test method produced before the software is created (software engineer)	Which type of test is used to measure the lifetime of a product reliability Advantages of TDD	Software Engineer Reliability Test driven design (TDD)	X
		Systems Programming/Software Development Developing small blocks of code			
2.3	Troubleshoot as a way of finding out why something does not perform to standards	Given multiple scenarios students must be able to determine how to trouble shoot	What is a probable reason that a car doesn't start Battery is dead		x
		Trouble Shooting Process Define the Problem Gather Information Analyze Data Eliminate Variables Propose hypothesis Test hypothesis Determine solution	Review and Create flow chart Trouble Shooting Process Define the Problem Gather Information Analyze Data Eliminate Variables Propose hypothesis Test hypothesis Determine solution		
2.4	Break down systems into their component parts and analyze their relationships and interdependencies	Breakdown from system to component, System, subsystem assemblies, subassemblies and components and clearly define the process to assemble	Multiple scenarios An example of Testing and evaluation surveys Given that set up with a center to center distance that is too loose, what will happen	Assemblies Subassemblies Turbine Pressure Cooker Pump	X

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			Examples of systems Turbine Pressure cooker Pump		
			Flow Charts Fish bones Concept Map Bubble diagram		
2.5	Examine the relationships between design criteria and such constraints as cost, time, quality, manufacturability, testability, maintainability, human factors, and environmental factors	Examine the relationships between design criteria and such constraints as cost, time, quality, manufacturability, testability, maintainability, human factors, and environmental factors	Activities related to product testing Affirm the quality and reliability of the product Determine if the product meets specifications Identify if the product meets customer needs Purpose of early prototype Quick feedback about the design Primary consideration in design work Standards and specification 3 models in engineering design conceptual, mathematical physical Parts of manufacturing process and what happens in them	Specifications Prototype Conceptual Design Mathematical Design Physical design Assembling Conditioning Finishing Forming	x

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			Assembling Conditioning Finishing and forming Reasons to use robotic systems Work continuously		
			Quality Systems Decision Matrix		
2.6	Develop and implement a plan for a project (i.e., time, materials, resources, and steps)	Elements of an engineering plan Timeline	List of tools Step by step process when an engineer offers a proposal to management cost and profitability Sketches must have a clear message not full concept Major tools for developing a plan for a project is sketching tools Gantt chart people resources and time Topics for brainstorming steps resources materials	Timeline Gantt Chart Profitability	X
			Create a timeline		

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STANDARD 3.0 – APPLY FUNDAMENTAL SCIENTIFIC LAWS AND PRINCIPLES RELEVANT TO ENGINEERING AND TECHNOLOGY

Measurement Criteria		Concept	Implementation	Terminology	Testing Item
3.1	Use the relationships among energy, work, and power to solve a variety of problems involving mechanical, fluid, electrical, and thermal systems		<p>Function of a variable resistor adjusting light intensity</p> <p>Open fluid system example Irrigation system Cooling system for auto Hydraulics for a truck Forced water heater system for a house</p> <p>Second law about thermodynamics heat and energy Drawing provided</p> <p>Arm Spring Constant k if this is doubled how does it change work it is 2 times a much</p> <p>Execute Circumference = (pie) x distance Resistance is double Word Problems</p>	<p>Radius Circumference Kilogram (metric conversions) Axle Friction Hydraulics Thermodynamics</p>	x

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			Describe how to increase torque supplied by motors to the wheels		
		<p>Electrical Electricity, Electrochemical, Fuse, Integrated circuit, motor, resistor, semiconductor, voltage, current, amps, AC/DC, Ohms Law, Watts, capacitor, diode, circuits, Mechanical Newton's Laws, gravity, Kinetic Energy – potential, Inertia, torque, simple machines, gears, gear ratio, pulleys, springs, (spring constants) Work = force x distance (work energy and power)</p> <p>Aerodynamics, trajectory, velocity, friction, drag, speed, acceleration, momentum</p> <p>Structural Loads, Force, Stress, bending moment, torsion, moments of inertia, torque, pressure, Biomedical,</p> <p>Optical Refraction, reflection, mirror, lenses(s)</p> <p>Thermal Heat transfer, convection, conduction, radiation, conservation of energy</p> <p>Fluid Hydraulic, pneumatic, open and closed system, Boyle's Law, pressure</p>	Forces acting on a static body (bridge project)		

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3.2	Use Newton's Laws of motion to analyze static and dynamic systems with and without the presence of external forces	Newton's 3 laws of motion Jet propulsion Relationship between gear speed and the number of teeth - Inverse ratio Compound gear system (3 or more gears)			X
		Mechanical Newton's Laws, Kinetic Energy – potential, Inertia, torque, simple machines, gears, gear ratio, pulleys, springs, (spring constants) Work = force x distance (work energy and power) Aerodynamics, trajectory, velocity, friction, drag, speed, acceleration, gravity, momentum			
3.3	Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, chemical (atomic), nuclear, biological, electrical, and thermal systems		Scenarios based around motion, water flow, fluid Heat transfer due to radiation	Hydraulic system Bernoulli's principle Thermal Nuclear Biological Atomic Momentum Conservation	x
		Mechanical Newton's Laws, Kinetic Energy – potential, Inertia, torque, simple machines, gears, gear ratio, pulleys, springs, (spring constants) Work = force x distance (work energy and power) Aerodynamics, trajectory, velocity, friction, drag, speed, acceleration, gravity, momentum			

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		<p>Fluid Hydraulic, pneumatic, open and closed system, Boyle's Law, pressure</p> <p>Electrical Electricity, Electrochemical, Fuse, Integrated circuit, motor, resistor, semiconductor, voltage, current, amps, AC/DC, Ohms Law, Watts, capacitor, diode, circuits, charge</p>			
3.4	Identify relevant chemical, environmental, mechanical (tension, compression, torque), electrical, and physical properties of materials used in engineering projects		<p>Materials that conduct electrical current in a computer chip</p> <p>Factor to change the electrical resistance of copper wire temperature</p> <p>The material that has replaced copper in telephone wiring fiber optic cable</p> <p>Given drawings identify compression points, tensile stress</p>	<p>Compression</p> <p>Torque</p> <p>Tension</p> <p>Coefficient of friction</p> <p>Coefficient of expansion</p> <p>Fiber optic</p> <p>Torsion</p> <p>Elasticity</p>	X
		<p>Electrical Electricity, Electrochemical, Fuse, Integrated circuit, motor, resistor, semiconductor, voltage, current, amps, AC/DC, Ohms Law, Watts, capacitor, diode, circuits, charge</p>			
3.5	Describe the relations between amplitude, wavelength,	Describe the relations between amplitude, wavelength, frequency, period, and speed of a wave for mechanical		<p>DC voltage</p> <p>AC Voltage</p> <p>Positive Terminal</p>	x

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	<p>frequency, period, and speed of a wave for mechanical and electromagnetic oscillations</p>	<p>and electromagnetic oscillations</p>	<p>Pictures of graphs best types to use for output signal of an inverter Effect of cooler conditions on the swing of clocks brass pendulum faster movement since the pendulum becomes shorter.</p> <p style="text-align: center;">Wavelength= $\frac{\text{Velocity}}{\text{Frequency}}$</p> <p>Why do AC voltage sources not have positive and negative terminals AC voltage is always changing</p> <p>Coherent light diagram</p> <p>Waveforms are represented using binary values digital signals</p> <p>2 areas of engineering most likely work with water and wind systems environment and mechanical</p>	<p>Negative Terminal Inverter Velocity Amplitude Wavelength Electromagnetic oscillations Chemical engineers Aerospace engineers Construction engineers</p>	
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			Read graphs regarding oscillation Chemical engineers Aerospace engineers Construction engineers		
STANDARD 4.0 – APPLY MATHEMATICAL LAWS AND PRINCIPLES RELEVANT TO ENGINEERING AND TECHNOLOGY					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
4.1	Apply appropriate data collection and analysis methods to display data (graphs, tables, formulas, and words)	Graphs what are they how are they used	Scatter plot Box plot Pie chart Bar graph Histogram Scattergram Plot graph	Scatter plot Box plot Pie chart Bar graph Histogram Scattergram Plot graph	X
			Spreadsheet		
4.2	Apply concepts of statistics to help make decisions	Apply concepts of statistics to help make decisions	Statistics tests deals with life span of a product reliability Other Forms Of Statistical Test Cost Estimation Feasibility Quality Performance	Time study Just in time Gantt Chart OHMS Law Cost estimation Feasibility	x

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			Quality Control Tool used that uses statistics to make sure products meet their specifications	Quality performance	
			Average/Mean Median/Mode Standard Deviation Range Tolerance Accuracy vs. Precision		
4.3	Use algebraic, geometric, and trigonometric relationships, characteristics, and properties to solve engineering problems	Use algebraic, geometric, and trigonometric relationships, characteristics, and properties to solve engineering problems	Images of force of compression Ohms law Solve for area Identify gear ratio given a problem Given the golden ration 1:1.618 solve a problem Identify the load of a ladder given a safety factor	Tension Terawatts	X
4.4	Evaluate mathematical solutions for reasonableness		Mathematical solutions for reasonable estimate for the circumference of a 2 inch diameter wheel	Circumference	X

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			Reasonable calculation for the length of a truss Area = πr^2 and Pressure (PSI) = <u>Force</u>		
		Evaluate mathematical solutions and determine they are logical and make sense in a real world situation		Estimate Predict	
4.5	Apply mathematical concepts to modeling		Mathematical concepts applied to modeling What is a scale in drawing Work = force x distance Mathematical acceleration of a vehicle	Parametric dimension	X
		Use scientific formulas and mathematical concepts to predict a result Develop geometric models using CAD			
STANDARD 5.0 – USE SYSTEMS OF MEASUREMENT					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
5.1	Convert units from one system of measurement to another	Convert units from one system of measurement to another	Given an logarithms example and must show characteristics What do media such as waveguide, air and space have	Logarithms Prototype Meter Kilometer Dimension	X

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			<p>in common all use electromagnetic waves</p> <p>Difference between scale and dimension Difference Meter stick and yard stick Meters in a Kilometer Miles to meters</p> <p>Computer application represents a physical prototype for an idea Computer Aided Design</p> <p>Characteristics of logarithms Math conversions Hours to seconds Feet per second Kilometers to Miles Watts to horsepower Radians to degrees</p> <p>Solve for cubic feet</p> <p>Precision and accuracy</p> <p>Given a problem calculate the minimum and maximum permissible limit</p>	<p>Radians Watts Horsepower</p>	
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			Read a line graph		
5.2	Apply precision, accuracy, and tolerance in measurement systems	Factoring by grouping Accuracy and Tolerance	Examples Problem analysis used by a production engineer	Precision Accuracy Tolerance Problem analysis Production Engineer	X
		The basics of tolerances			
STANDARD 6.0 – APPLY ENGINEERING TECHNOLOGY AND TOOLS					
Measurement Criteria		Content	Implementation	Terminology	Testing Item
6.1	Use software tools to solve problems, model, and display data	Use software tools to solve problems, model, and display data	Software computer tools used for What would you use to develop ISE Integrated Software Environment	ISE Integrated Software Environment	X
		When to appropriately use CAD, Spreadsheets, graphic calculators, solving software			
6.2	Use appropriate devices such as calipers, oscilloscopes, and digital multimeters		Series circuit schematic What does Caliper measure Oscilloscope measures wave length Digital Multi Meter	Design software CAD CAM Data base Oscilloscope Calipers Digital Multimeter	X

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		Understanding and using measuring devices such as calipers, oscilloscopes, and digital multimeters			
6.3	Interpret graphical data such as plans, diagrams, and working drawings		<p>Construction Diagram as it refers to measurements, and parts Diagram of a prototype of a motor</p> <p>Orthographic Projection = to a parallel Projection</p> <p>Freehand sketches must clearly communicate message</p> <p>Scale Drawing what is it and when to use</p>	Diagram Orthographic Projection Parallel Projection	X
		Create drawing using CAD			
6.4	Recognize safe use of tools, machines, equipment, and materials		<p>Safety glasses use</p> <p>PPE reduces injury</p> <p>Report damaged equipment o reduce future injury</p> <p>Vise or clamp used to secure</p> <p>Read operational manuals prior to starting</p>	Vise Clamp OSHA	x

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			Cutting edges of a separating tool must be harder than the material being cut		
		Practice proper safety rules.	General safety rules I.e. Eye Protection, Hearing, Breathing, Feet, Hair etc. Tools And Machine Specific Safety		
STANDARD 7.0 – IDENTIFY DIFFERENT DISCIPLINES WITHIN THE FIELD OF ENGINEERING					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
7.1	Identify the responsibilities of the various engineering disciplines such as mechanical, software, architectural, civil/structural, electrical, chemical, and mining		Software engineers Mining Engineer Civil Engineer Mechanical Engineer Nanotechnology Engineer Atomic Engineering Responsibilities of a civil engineer regarding mining A systems engineer would be responsible for a very complex engineering design A process engineer designs, collects, and analyzes manufacturing data	Software engineers Mining Engineer Civil Engineer Mechanical Engineer Nanotechnology Engineer Atomic Engineering Robotics Engineer	X

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		Research the roles and responsibilities of engineering disciplines			
7.2	Compare and contrast the responsibilities of various engineering discipline such as mechanical, software, architectural, civil/structural, electrical, chemical, and mining	Compare and contrast responsibilities of various engineers	Architectural Engineer Chemical Engineer Electrical Engineer Industrial Engineer Transportation Engineer Aeronautical Engineer Importance of math in education, and coursework required Explain the difference between an electrical engineer and an electronic engineer	Architectural Engineer Chemical Engineer Electrical Engineer Industrial Engineer Transportation Engineer Aeronautical Engineer Computer Engineer Manufacturing engineer Aerospace engineer Industrial Engineer	X
				Environmental Engineer Automotive Engineer Biomedical Engineer Materials Engineer	

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				Petroleum Engineer (*AZCIS, Kuder, Naviance ECAP)	
7.3	Identify the skills and education needed to enter a particular field of engineering	Research the roles and responsibilities of engineering disciplines			x
STANDARD 8.0 – USE AUXILIARY EQUIPMENT AND TOOLS					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
8.1	Recognize the societal, legal, and ethical responsibilities of engineering		Responsibilities that are societal, legal and ethical, what are examples Registered engineer		X
		Critique the societal, legal, and ethical responsibilities of engineering in real life situations			
8.2	Recognize the impact of engineering from multiple perspectives, such as, economic, environmental, political, sustainable, and health and safety		Engineering field have increased due to advances in technology, science, medicine and society	Safety Factor	X
		Analyze the impact of engineering from multiple perspectives, such as, economic, environmental, political, sustainable, and health and safety at the current Issues, local, national, international		Patents Liability Environmental Impact	

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Terminology

A

AC Voltage (current) - alternating current: an electric current that reverses direction

AC/DC - alternating current: an electric current that reverses direction, direct current: an electric

Acceleration - The rate of change of velocity per unit of time ($a=\Delta v/\Delta t$)

Accuracy - The degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard; exactness

Aeronautical engineer – another name for an Aerospace engineer, a person who designs machines that fly

Aerospace engineer —a person who designs machines that fly

Alternating Current – Electric current that reverses direction

Alternative - Available as another possibility

Ampere (AMP) – A measure of electrical current flow

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Amplitude - the maximum displacement from a zero value during one period of an oscillation of a wave

Analysis – A detailed examination of the elements or structure of something

Analyze –To examine of the elements or structure of something application at a molecular level application of extracting and processing minerals from a naturally occurring environment

Archimedes Principle - Any object wholly or partly immersed in fluid will be buoyed up by a force equal to the weight of the fluid displaced by the object

Architectural Engineer - An engineer who specializes in the structural, mechanical, electrical, construction of buildings

Area - A part of an object or surface

Assembling – Putting together Individual parts to create a final product

Assembly – Individual parts that fit together to create a final product

Assessment – An evaluation technique

Atomic – Relating to an atom, the smallest particle of a chemical element

Atomic Engineering – another name for Nuclear Engineering, the branch of engineering concerned with the application of the breakdown of atoms as well as the fusion of atomic nuclei and/or the application of other sub-atomic physics.

Automation – A machine or system that operates with minimal human control that works independently without control from the outside, acting independently or having the freedom to do so

Autonomous- Acting independently or having the freedom to do so

Axle - A central shaft for a rotating wheel or gear

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B

Balance – A condition in which different elements are equal or in the correct proportion

Bar graph - a chart with rectangular bars with lengths proportional to the values that they represent

Beam - A horizontal part of a structure that is supported at both ends

Bernoulli's Principle - The principle in hydrodynamics that an increase in the velocity of as the speed of fluid increases, its pressure decreases)

Binary – 0 or 1, a base 2 system of measurement

Biological – relating to the science of life or living matter in all its forms

Biomedical engineering—engineering related to both biology and medicine

Biometrics—the method of patterning a machine's structure based on structures found in nature (i.e., humanoid robotics)

Bit—computer related, refers to something that holds just a single piece of binary information

Box plot - a convenient way of graphically depicting groups of numerical data through their quartiles

Boyle's Law – the volume of a gas at a constant temperature is inversely proportional to its pressure

Brainstorming – a method of shared problem solving in which all members of a group spontaneously and in an unrestrained discussion generate ideas and solve problems.

Bridge—a structure built to allow people and vehicles to pass over something, i.e., rivers, ravines, canyons, etc.

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Buoyancy—the upward force on an object in a fluid, equal to the weight of the fluid displaced by the object. The ability or tendency to float in water or other fluid.

By product – Something produced in the making of something else

Byte—a unit of computer storage containing eight bits

C

Caliper - An instrument for measuring external or internal dimensions: measuring thicknesses and diameters to a very high degree of precision, having two hinged legs resembling a pair of compasses and in-turned or out-turned points

CAM - a rotating or sliding piece in a mechanical linkage used especially in transforming rotary motion into linear motion or vice-versa

Cantilever—a structural member which projects beyond its support and is supported only at one end

Capacitor—a device capable of storing electric charge

Capital – accumulated finances (money), goods and tools used in the production of other goods

Center of gravity – the point at which the entire weight of a body may be considered as concentrated so that if supported at this point the body would remain in equilibrium

Chemical Engineer – a person who works principally in the chemical industry to convert basic raw materials into a variety of products, and deals with the design and operation of plants and equipment to perform such work

Circuit—in electricity and electronics, a series of electrical components through which electricity may flow

Circumference - The enclosing boundary of a curved geometric figure - the perimeter of a circle $c=\pi d$ or $c=2\pi r$

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Clamp - a device for strengthening or supporting objects or fastening them together

Client – a person using the services of a professional person or organization

Closed (Loop) System – a system that uses feedback from the output to control the input

Closed System - A physical system on which no outside influences act; closed so that nothing gets in or out of the system and nothing from outside can influence the system's observable behavior or properties.

Coefficient of expansion - describes how the size of an object changes with a change in temperature

Coefficient of Friction - the force required to move two sliding surfaces over each other

Coherent - consistent

Column – a vertical support Component – a part or element of a larger whole

Communication System – a system that forms a link between a sender and a receiver, making possible the exchange of information

Component – a part or element of a larger whole

Composite – a material formed from a combination of other materials

Compound – a substance of two or more elements in fixed proportions

Compound gearing system – a gearing system that consists of two or more gears

Compound Machine – a mechanism that consists of two or more simple machine

Compression – a force that pushes on or squeezes a material

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Computer Aided Design (CAD) – the use of a computer to create drawings

Computer Numeric Control (CNC) –a combination of a computer, a digital control system and a machine that is used to make objects

Computer-Aided Design (CAD) - is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design

Computer-Aided Manufacturing (CAM) - techniques for employing computers in manufacturing processes

Conceptual Design - it is the creation and exploration of new ideas

Conditioning - a process in which heat, chemicals, or mechanical forces are used to change the internal structure of a material

Conduction - The process by which heat or electricity is directly transmitted through a substance when there is a difference of temperature or of electrical potential between adjoining regions, without movement of the material.

Conductors - A material or device that conducts or transmits heat, electricity, or sound, esp. when regarded in terms of its capacity to do this.

Conservation - measurable property of a physical system that does not change, for example conservation of energy and mass

Constraint –a limit, such as appearance, budget, space, materials, or human capital in the design process: a limit to the design process

Construction engineer – a person who deals with the designing, planning, construction, and management of infrastructures such as highways, bridges, airports, railroads, buildings, dams, and utilities

Contractor - a person who is hired to furnish supplies or perform work

Convection – the transfer of heat energy by moving a heated substance from one place to another

Correlation - statistical relationship between two variables

Cost estimation - is the approximation of the cost of a program, project, or operation

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Creativity—the ability to make or bring a new concept or idea into existence

Criteria – principles or standards by which something may be judged

Criteria—special requirements that a product has met or must meet

CRT-

Current – the total amount of electrons flowing through a circuit per unit time; measured in Amperes (Amps)

D

Dam—a structure built across a body of water to control or block its flow Data base – a collection of data organized for easy access

Data – facts and statistics used for reference or analysis.

Data base – a collection of data organized for easy access

DC voltage (current) – current that flows in one direction

Dead loads—material used to build the structure itself which does not move

Decision matrix—an arrangement of elements to help solve a problem

Degree of freedom—the ability to move in a certain direction

Design – a plan or drawing produced to show the look and function or workings of something before it is built or made

Design Brief – a written plan that identifies a problem to be solved, its criteria and constraints

Design process—a systematic problem-solving strategy used to satisfy human wants or needs

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Design proposal—the act of offering or suggesting something for acceptance

Design software – Computer Aided Design software is used to create two dimensional or three dimensional models

Design Statement (Problem Statement) – a part of the design brief that challenges the designer, describes what a design solution should do and identifies the degree to which the solution must be executed

Deviation – the difference between the observed value and the known true value

Devices - A thing made or adapted for a particular task, esp. a mechanism or electronic instrument

Diagram – a drawing that outlines or explains how something works

Diameter - a straight line passing from side to side through the center of a circle or sphere

Digital electronics—uses digital logic to operate an electronic system

Digital Multimeter – a device that is used to measure the voltage or amperage in an electrical circuit

Dimension—sizes and notes placed on a mechanical drawing that note an objects linear measurements, as well as noting the location of an objects features

Displacement— the difference between the final and initial position of a point or the weight or volume of a fluid moved or shifted by a floating body

Documentation—the organized collection of records and documents that describe a projects, purpose, processes and related activities for future reference

Drag—a force that causes resistance to moving through the air, resistance of the air (technically a fluid) against the forward movement of the plane, the force that acts opposite to the direction of motion caused by friction and differences in the air pressure, and the resistance of the motion of an object through a fluid

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Dynamic loads—are caused by the forces of motion

E

Economics—the social science that deals with the supply of and demand for goods and services effects.

Elasticity - The ability of an object or material to resume its normal shape after being stretched or compressed

Electrical engineer—a person who designs electronic systems and products

Electrical Power - Electric power is the rate at which electrical energy is transferred by an electric circuit Electrification—the process of making electricity available within a region or country

Electromagnet—a metal core that is rendered magnetic by the passage of an electric current through a surrounding coil

Electromagnetism oscillations (electromagnetic oscillations) – electromagnetic waves do not require a medium. Instead, they consist of periodic oscillations of electrical and magnetic fields generated by charged particles, and can therefore travel through a vacuum

Electromagnetism- the relationship between electric and magnetic fields and their interactions with each other and with electric charges and currents

Electron—a part of the atom that contains a negative charge and orbits the nucleus

Electronics—the study and control of the flow of electrons, usually involving voltage

Element – a basic part

Energy—the ability to do work

Engineer- a person who is trained in and uses technological knowledge to solve practical problems

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Engineering (design) process—applies math, science, and engineering principles to the decision making process; this is an ongoing process

Engineering Notebook – a notebook to record ideas generated while an engineer researching and designing a new product or process

Engineering—the process of designing solutions

Entrepreneur—a person who establishes a new enterprise or business and assumes financial risk in the hope of gaining wealth

Equilibrium—the sum of all forces is equal to zero ($\Sigma F=0$)

Ergonomics - the study of workplace equipment design or how to arrange a workplace so that people interact and work safely and efficiently

Ethics— a set of moral principles or values; a branch of philosophy that considers own to apply concepts or right and wrong and taking responsibility for one's own actions

Evaluate – to form an idea of the amount or value of a product or process

Evaluation—the process of collecting analyzing information and data to determine how well a design meets requirements

Experimentation—the act of conducting a controlled test on an prototype

Extrusion – a manufacturing process that forces metal through a shaped opening

F

Failure Analysis – experimenting with an object when it fails to determine what happened

Fastener – a hardware device that mechanically joins or affixes two or more objects together

Feasibility – Determining if something is achievable

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Feedback—information about the output of a system that can be used adjust it at the input

Fiber optic – A cable that is used to carry light

Finishing – a manufacturing process that changes the surface of a manufactured item to achieve a certain property flow through the external circuit.

Fluid Power – power created by pressurized fluids, either gasses or liquids

Fluid—a gas or liquid that tends to take the shape of its container force equal to the weight of the fluid displaced by the object

Force—the transferring of energy from one object to another object

Forming – A metal working process where the shape of the metal is changed without adding or removing material

Form—the principle of design that described by lines and shapes

Formula – a mathematical relationship or rule expressed in symbols

Frequency – the rate at which something occurs over a particular period or in a given sample

Friction – resistance to the relative motion of two solid objects along the surfaces in which they touch

Fulcrum –the point around with a lever turns or is supported

Function –the kind of action or activity proper to a person, thing or institution; the purpose for which something is designed or exists

G

Gantt Chart - A project timeline that takes into account the number of resources and the timing of tasks that make up the project

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Gear – a wheel with teeth that will allow the transfer of power when coupled with another gear

Gear Ratio – the ratio of the rotational speeds of the first and final gears in a train of gears or of any two meshing gears

Gear Reduction – increase or decrease in rotational speed based on the gear ratio

Generator – a device that converts mechanical energy to electrical energy

Geotechnical engineer Geotechnical engineering is the branch of civil engineering concerned with the engineering behavior of earth materials.

Gram - a metric system unit of mass

Graph –a diagram showing the relation between variable quantities, typically of two variables measured along a pair of axes at a right angle

Graphical Communications – a form of communication that uses graphical representations to illustrate data and concepts

Gravity – the force of attraction by which objects tend to fall toward the center of the earth

H

Histogram - A bar chart that shows the frequency of an occurrence for a predetermined set of values

Horsepower - A measure of power or the rate that work is being done. One horse power is equivalent to 745.699872 Watts

Hydraulic system (Bernoulli's principal) - In fluid dynamics, Bernoulli's principle states that for an increase in flow, an increase in the speed of the fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy.

Hydraulics - A fluid system that uses a liquid for its transfer medium

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Hypothesis – an assumption made on the basis of limited evidence as a starting point for further investigation

I

Impact – the effect or influence of one thing on another

Implementation – to put into effect according to a definite plan or procedure in an engaging way such as with text, pictures, sound and video.

Inclined Plane – a flat sloping surface along which an object can be pushed or pulled

Inclined Plane – a flat sloping surface along which an object can be pushed or pulled

Industrial Engineer- a branch of engineering dealing with the optimization of complex processes or systems. It is concerned with the development, improvement, implementation and evaluation of integrated systems of people, money, knowledge, information, equipment, energy, materials, analysis and synthesis, as well as the mathematical, physical and social sciences together with the principles and methods of engineering design to specify, predict, and evaluate the results to be obtained from such systems or processes. Its underlying concepts overlap considerably with certain business-oriented disciplines such as operations management.

Inertia—the property of an object to resist a change in movement

Ingenuity—a person’s natural ability to solve problems

Innovation – an improvement of an existing technological product, service or process, system or method of doing something

Innovative activities - Activity focused on using innovative approaches to problem solving

Input – something put into a system, such as resources, in order to achieve a result

Insulator—a material that does not allow electrons to pass freely

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Interaction- the activity of returning a previous step in the design process

Integrated Software Environment (ISE) - Software tools, such as editor, compiler, linker that are used to develop application software or "App" are integrated together to enable software development to be user friendly

Interference – the amount of overlap that one part has with another when assembled

Invention – a new product, system or process that has never existed before, created by study and experimentation

InverterDigital- Outputs a state that is opposite that of that of the input. Power-Changes Direct Current to Alternating current.
Involving the recognition and formulation of a problem, the collection of data through

ISE Integrated Software Environment- Software tools, such as editor, compiler, linker that are used to develop application software or "App" are integrated together to enable software development to be user friendly.

Isometric drawing – a form of pictorial drawing in which all the drawing axes form equal angles of 120 degrees with the plane of projection

Iteration - the act of repeating a process to reach a desired goal or target

Iterative –describing a procedure or process that repeatedly executes a series of operations until some condition is satisfied. An iterative procedure may be implemented by a loop in the routine

J

Just in time- The concept of ordering raw material in the quantity and time needed to produce an ordered product. Likewise, the product is not built until an order for that product is in place. A production strategy that strives to improve a business' return on investment by reducing in-process inventory and associated carrying costs

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K

Kilogram – 1000 grams; A common unit of mass in the metric system equivalent to 2.2 pounds

Kilometer- 1000 meters: A common unit of length in the metric system equivalent to 0.621371192 miles

Kinematics—the study of motion

Kinetic energy—energy that is in motion or a result of potential energy being released

L

LASER – (Light Amplification by the Stimulated Emission of Radiation) - A device that produces a concentrated and coherent beam of light

Lever—a plane (stick or bar) which has a fulcrum (pivot point) to create mechanical advantage

Lift—a component of aerodynamic forces acting on an object in flight, a force produced by an airfoil shape that works against gravity, the force that acts at a right angle to the direction of motion through the air created by the differences of air pressure, the force that directly opposes the weight of an airplane and holds the airplane in the air

Live loads—a moving, variable weight added to the dead load or intrinsic weight of a structure or vehicle

Load - A heavy or bulky thing that is being carried or is about to be carried.

Logarithms-The power a base is raised to in order to obtain the value. For example the Base 10 logarithm of 100 is 2.

M

Machine – A device with fixed and moving parts that modifies mechanical energy in order to do work

Magnetism – A force that exists around magnets that attracts ferrous materials and is used in motors and generators

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Maintenance – The work needed to keep something in proper condition

Manufacturer—one who uses tools and machines to turn raw materials into usable objects

Manufacturing processes—the transformation of raw materials into finished goods

Manufacturing—the use of tools and machines to convert materials into usable objects

Manufacturing engineer- a discipline of engineering dealing with different manufacturing practices and includes the research, design and development of systems, processes, machines, tools and equipment; responsible for handling, packing, processing

Mapping - Making a representation of an area of the earth

Market Research – The activity of gathering information about consumers’ needs and preferences

Mass—the amount of material that an object contains materials science for analysis, design, manufacturing and maintenance of mechanical systems

Materials— a description of a system using mathematical concepts the resources from which things are made

Mathematical Design—a description of a system using mathematical concepts

Mean – The average or central value of a set of numbers

Mechanical advantage—the increased force gained by using a machine

Mechanical Engineer—engineering discipline that applies the principles of engineering, physics and materials science for analysis, design, manufacturing and maintenance of mechanical systems

Mechanical Power - The power produced by motion (work divided by time)

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Mechanical Wave - a wave that propagates as an oscillation of matter, and therefore transfers energy through a medium

Mechanics—a branch of physics involving the study of motion and movement

Mechanism—a system made up of a number of parts, which may include simple machines

Median – The middle number in a set of a sequence of numbers

Meter—the fundamental length in the metric system

Micrometer - A gauge that measures small distances or thicknesses between its two faces, one of any of various devices for measuring minute distances and angles

Mining Engineer—engineering discipline that involves the practice, theory, science, technology and application of extracting and processing minerals from a naturally occurring environment

Mode –The number that occurs most often in a set of numbers

Models—a three dimensional representation of a person or thing of a proposed structure

Momentum—the quantity of motion of a moving body, measured as a product of its mass and velocity

Multi-meter - An instrument designed to measure electric current, voltage, and usually

N

Nanotechnology Engineer - engineers who design processes and devices as small as millionths of a millimeter

Nanotechnology –Measured as 1 billionth of a meter, nanotechnology is the study and application of sub atomic things and can be used across all the other science fields, such as chemistry, biology, and engineering. The science and technology of devices and materials, such as electronic circuits or drug delivery systems, constructed on extremely small scales, as small as individual atoms and molecules.

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Negative Terminal—the terminal of a battery or other voltage source that has more electrons than normal

Newton's first law of motion—a body tends to stay at rest or in uniform motion unless acted upon by an outside force; inertia

Newton's laws- explain the relationship between the forces that are acting on a body and the motion of that body

Newton's second law of motion—the net force on an object is equal to the mass of the object multiplied by the change in velocity of the object

Newton's third law of motion—for every action there is an equal and opposite reaction

Nonrenewable – An object, thing or resource that cannot be replaced

Nuclear—of, relating to, or consisting of a nucleus

O

Observation –the act of noticing or perceiving

Ohm – a measure of electrical resistance

Ohm's Law—the law stating that the direct current flowing in a conductor is proportional to the potential difference between its ends. $V=IR$

Open-loop system—the simplest type of system which requires human intervention to be regulated

Optimization—an act, process or methodology that is used to make a design as effective or as functional as possible with the given criteria and constraints

Ordinate—the y-coordinate of a point on a Cartesian plane, the points distance from the x-axis

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Orthographic Projection Parallel Projection—a method of projection in which an object is depicted or a surface mapped using parallel lines to projects its shape onto a plane

Oscilloscope—a device for viewing oscillations, such as electrical voltage or current, by a display on a CRT

Output – The results of the operation of any system

P

Parabolic Motion – The shape of the motion of a projectile

Parallel circuit—a circuit that has more than one path for the current to flow

Parameter – a quantity that is fixed for the case in question but may vary in other case

Parametric dimension: A dimensions controls the model geometry; changing the dimension changes the shape of the model: type required to enable model scaling with the minimum amount of change

Parts List – A list of materials or parts specified for a project. Otherwise known as a bill or materials (BOM)

Passive Solar - accumulating and distributing solar heat without the aid of machinery

Physical design: Physical design is the process of converting the conceptual design into a physical form. Conceptual designs are converted into geometric representations which ensure the required functioning of the components Pie chart

Pie chart: A pie chart is a circular chart divided into sectors; each sector shows the relative size of each value

Plane – A flat surface on which a straight line joining any two point would lie completely

Plasticity – the quality of being flexible or able to be molded

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Plot graph: A plot graph shows data on an x-axis and frequency on the y

Pneumatics – A type of fluid power that uses compressed air or other neutral gasses

Pneumatics – A type of fluid power that uses compressed air or other neutral gasses

Positive Terminal: The terminal of a battery or other voltage source toward which electrons flow through the external circuit

Potential Energy – The energy of a particle, body or system that is determined by its position or structure

Power—the rate at which energy is transferred

Precision: Exact in measuring and recording: related to reproducibility and repeatability, is the degree to which repeated measurements under unchanged conditions show the same results

Presentation Software: A computer program designed to allow the user to present information in an engaging way such as with text, pictures, sound and video

Pressure—force applied uniformly over a surface, measured as force per unit area

Problem analysis- the process of understanding problems and proposing solutions to those problems

Problem Solving - the thought processes involved in solving a problem

Process – The action of going through several steps to reach a desired goal

Product – A tangible artifact produced by means of either human or mechanical work, or by biological or chemical processes

Product Lifecycle – Stages a product goes through from the concept and use to eventual failure or withdrawal from the market place.

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Product Lifecycle – Stages a product goes through from the concept and use to eventual failure or withdrawal from the market place.

Production Engineer: An engineer that design systems for producing goods and providing services

Profitability: The quality or state of making money or producing good or helpful results or effects

Proportions – The relationship of one thing to another in size or amount

Proposal - a plan presented before a project is started

Propulsion System- A system that provides the energy source, conversion and transmission of power to move a vehicle

Protocol – The accepted code of behavior in a particular situation

Prototype: An early sample, model or release of a product built to test a concept or process or to act as a thing to be replicated or learned from

Pulley – a grooved wheel around which a rope, belt or chain passes that is used to change the direction of a force or change the amount of force, increasing the mechanical advantage

Pump – A device that converts mechanical energy to fluid energy

Pythagorean Theorem - A theorem stating that the square of the length of the hypotenuse of a right triangle is equal to the sum of the squares of the lengths of the other sides ($a^2 + b^2 = c^2$)

Q

Quality Control – A system by which a desired standard of quality in a product or process is maintained

Quality performance: A numerical measurement of the performance of a product or process to a desired specification

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R

RADAR – (Radio Detection and Ranging) a method for detecting the position and velocity of a distant object

Radians: A unit of measure for angles equal in length to the radius of the circle

Radiation – Transfer of heat by temporarily transforming the heat (kinetic motion of an object's atoms or molecules) into electromagnetic waves (in the infrared part of the EM spectrum), these wave travel until they are absorbed by another object and then transferred back into atomic/molecular kinetic energy which is heat

Radius: The distance from the center point of a circle to any point to any point on its edge

Range – The measure of variation that is the difference between the highest and lowest scores

Ratio – The quantitative relation between two amounts showing the number of times one value contains or is contained within the other

Raw Material – Any natural resource that is used to make finished products

Raw materials—the unprocessed resources from which a thing is made

Reasonableness – logical

Receiver – The part of a communication system that picks up or accepts a signal or message from a channel and converts it to perceptible form

Reliability: the extent to which an experiment, test, or measuring procedure yields the same results on repeated trials

Renewable – A resource or raw material that can be grown and replaced

Repeatability – The ability to replicate or duplicate a result

Requirements – The parameters placed on the development of a product or system. The requirements include the safety needs, the physical laws that will limit the development of an idea, the available resources, the cultural norms and the use of criteria and constraints

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Research –The systematic study of materials and sources in order to establish facts and reach new conclusions resembling a pair of compasses and in-turned or out-turned points.

Resistance - the act or power of resisting, opposing, or withstanding

Resistance (Electrical) – The ratio of the potential difference across an electrical component to the current passing through; it is a measure of the component's opposition to the flow of electrical charge

Resistance (R)—the opposition to the passage of an electric current in an object or material (measured in Ohms Ω) resistance, typically over several ranges of value

Resistor—an electronic device designed to optimize the flow of current and control the voltage applied to a circuit

Resources – Something that has value which can be used to satisfy human wants and needs; the things needed to get a job done. In a technological system, the basic resources are energy, capital, information, machines and tools, materials, people and time

Responsibility - reliability or dependability

Reverse Engineering – The process of taking something apart and analyzing its workings in detail, usually with the intention to understand function, prepare documentation, electronic data or construct a new or improved device

Risk – the chance or probability of loss, harm failure or danger

Robot—a programmable system that can sense its environment, compute actions, and act on the environment to perform a task or achieve a goal

Robotics—the science and technology of robots

Rollout – the distance a wheel travels in one rotation of the wheel

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S

Safety Factor- the ratio of the material strength to the actual stress

Scale - a proportion between two sets of dimensions used in developing accurate, larger, or smaller prototypes or models of design ideas

Scatter plot- A graph made by plotting ordered pairs in a coordinate plane to show the correlation between two sets of data

Scattergram- Same as a Scatter Plot

Schematic – a drawing or diagram of a chemical, electrical or mechanical system

Scientific Process - The principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses.

Screw – an inclined plane wrapped around a cylinder, used as a threaded fastener

Semiconductor—a material that is neither a good conductor or a good insulator; its conductivity can be altered by manufacturing

Sender- a person or equipment that causes a message to be transmitted

Sequential—forming or following a logical or sequence

Series circuits—a circuit that has only one path for the current to flow

Shear – force that acts parallel to the surface of the material

Simple Machine – any of several elementary mechanisms that are used to transmit or modify force or motion. Simple machines include the lever, wheel and axle, pulley, screw, wedge, and inclined plane

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Sketch – a rough drawing representing the main features of an object or scene and often made as a preliminary study

Software Engineer: Software engineers develop computer software systems

Span - the distance a bridge extends between two supports

Specification: An explicit set of requirements to be satisfied by a material, design, product, or service

Spread sheet: an interactive computer application program for organization and analysis of data in tabular form

Spring – a mechanical device that stores energy by expansion or contraction due to pressure, force, or stress applied, that will release energy and return to shape when the force or stress is removed

Stable - ability to resist collapse and deformation

Static loads—are associated with a load at rest

Statics—the study of how forces affect non-moving objects

Strain—describes the change in shape of a material caused by compression or tension forces stream of fluid results in a decrease in pressure

Stress – a material’s internal resistance to force

Structure—a body that supports a load and resists external forces without changing shape, except due to the elasticity of the materials used in its construction surface mapped using parallel lines to projects its shape onto a plane

Subassembly – an assembled part that is part of a larger assembly

Sustainability- is the capacity to endure

System – a group of interacting, interrelated, or independent elements or parts that function together as a whole to accomplish a goal

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T

Technology—the process humans use to develop new products to meet their needs and wants; products that artificially made

Tension – a force that pulls on a material

Terawatts - is equal to one trillion (10^{12}) watts

Thermal - of, pertaining to, or caused by heat or temperature

Thermodynamics – the study of thermal energy as it moves from one substance to another

Time study – use to establish standard times used with a motion study, a technique for improving work methods

Timeline - a schedule or timetable

Tolerance – the difference between the maximum and minimum dimensions allowed within the design of a product

Tool – a device that is used by humans to complete a task

Torque – a turning or twisting force that produces or tends to produce rotation or torsion

Torsion – the twisting of a material

Transmit – to send or convey a coded or non-coded message from a source to a destination

Transportation Engineer - a person who applies technology and scientific principles to the planning, functional design, operation and management of facilities for any mode of transportation in order to provide for the safe, efficient, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods

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Triangle is equal to the sum of the squares of the lengths of the other sides ($a^2 + b^2 = c^2$)

Troubleshoot – to locate and find the cause of problems related to technological products or systems

U

Utilities—service systems to a building

V

Validate - in engineering it is used to confirm that a product or service meets the needs of its users

Variance/Variation – a change or slight difference in condition, amount or level

Velocity - The speed of something in a given direction

Vise - a mechanical apparatus used to secure an object to allow work to be performed on it

Voltage – the electromotive force in a circuit

Volume – the amount of space occupied by a three-dimensional object as measured in cubic inches

W

Watt - a derived unit of power in the International System of Units (SI)

Wavelength - the distance over which the wave's shape repeats

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Wedge – a simple machine with a thick end that tapers to a thin edge, that is driven between two objects or parts of a object to secure or separate them

Wheel and axle – a simple machine that rotates in a circle around a center point or fulcrum to lift or move an object (turns rotary motion into linear motion) which can be moved away from or toward the other by turning a screw with a fine thread.

Word processing - an electronic device or computer software application that, as directed by the user, performs word processing: the composition, editing, formatting and sometimes printing of any sort of written material

Work—the amount of force required to move an object a set distance; the transfer of energy from one physical system to another