**Technology, Science, Engineering**

* Portfolio
  + A collection of work to showcase someone’s ability
* Technology
  + Development in the human world
  + Can have trade offs such as pollution
  + Innovation
    - Improvement of existing technology
* Product
  + Item created by human, chemical or biological process
* Timeline
  + Shows events chronologically
* Engineering
  + Using science, technology, art, math to create products that solves a problem
  + Chemical Engineering
    - Apply chemistry and physics to create a product that undergoes chemical changes
  + Civil Engineering
    - Plan, design, and supervise construction in public and private
  + Electrical Engineering
    - Work focused electrical systems
  + Mechanical Engineering
    - Apply mechanics and energy to products
  + Technical Writing
  + expository writing used to convey information for technical or business purposes.
  + Technical Report
    - Document conveying results of scientific and technical research that provides recommendations for action.
    - Includes Abstract, Table of Contents, Figures, Appendices

**Design Briefs**

* Design
  + Decision making process that produces plans of the usage of resources to meet human needs and wants or solves problems
* Designer
  + A person who designs
* Iterative
  + a procedure that’s ongoing until requirements are met
* Design Brief
  + Plan
  + Identifies
    - problem
    - Criteria
    - Constraints
    - encourage consideration of all aspects before planning
  + Problem Identification
    - Identifies a problem
  + Design Statement – A part of the design brief that challenges the designer, describes what design solution should do without describing how to solve the problem, and identifies the degree to which the solution must be executed
  + Client – A person using the services of a professional person or organization
  + Target Consumer – A person or group for which product or service design efforts are intended
  + Constraint – A limit to a design process. Constraints may be such things as appearance, funding,space, materials and human capabilities. (A limitation or restriction)
    - Parallel 
      * Makes lines parallel -not meet
    - Perpendicular 
      * Make lines perpendicular -intersect a right angles
    - Concentric 
      * Makes circles share center points
    - Coincident 
      * Makes points coincident -same place
    - Collinear 
      * Makes lines collinear -same line
    - Equal 
      * Makes things congruent
    - Fixed 
      * Fixes a thing in place
    - Tangent 
      * Makes things meet at one point
    - Horizontal 
      * Make horizontal
    - Vertical 
      * Make vertical
    - Symmetrical 
      * Reflect over an axis
    - Smooth 
      * Rounds a corner to an arc
    - Numeric Constraint – a number value or algebraic equation that is used to control the size or location of a geometric figure
    - Geometric Constraint – Constant, non-numerical relationships between parts of a geometric figure.
  + Product
    - tangible artifact produced by human, mechanical work, biological or chemical process
  + Criteria
    - Standards something may be judged by
  + Annotate
    - Adding explanatory notes

**Engineer’s Notebook**

* record of design ideas that others may not claim as their own.
* Conventions
  + Pages are sequentially numbered in ink on the top outside edge.
  + All figures and calculations are clearly labeled.
  + Entries start at the top of the page, working left-to-right and top-to-bottom.
  + Each page is signed and dated by a witness before the next page is begun.
  + Inserted items are permanently attached.
  + Mistakes are crossed off, initialed, with correction. Never erase anything.
* Annotate
  + adding explanatory notes

**Measurement**

* Standard
  + Something set by consensus as a basis of comparison.
  + American National Standards Institute (ANSI)
    - Develops standards for US
  + International Organization for Standardization (ISO)
    - Develops standards globally
* Variation
  + A change in condition, amount or level.
* Significant Digits
  + The digits that contribute to the accuracy of the quantity
  + All digits recorded for a measurement are considered significant
  + Include all certain digits in a measurement and one uncertain or estimated digit
  + Leading zeroes are not significant digits while trailing zeroes are
  + A standard quantity that other quantities are expressed in terms of it
  + Customary units
    - inch/foot
      * 12 in. in a ft
    - Pound
    - In US only
  + Metrics units (SI – International System of Units)
    - The decimal measuring system
    - Meter
      * 1000 mm in a m
    - Liter
    - Gram
    - Used globally
  + Conversion rate from customary System to Metric System: 1 inch = 25.4 mm
* Caliper
  + Fit object between racks
  + Look at measurement indicated by reference edge, and decimal measurements in the dial

**Design Process**

* Model
  + visual, mathematical, or three-dimensional representation in detail of something, often at a smaller scale.
  + Used to
    - test ideas
    - make revisions to a design
    - Simulate what would happen to a similar, real object.
* Prototype
  + A 1:1 scale, working model to test a design by making observations and adjustments
* Mockup
  + Appearance Model
  + Copy of a structure for instructional or experimental purposes
* Process
  + sequence of actions that puts resources together for an output
* Sequential
  + following a logical order
* Ergonomic
  + The study of design so that people and things interact safely and most efficiently.
* Arbitration
  + Settling differences between parties
* Consensus
  + agreement
* Critique
  + A detailed analysis
* Decision Matrix
  + Ranks concepts based on criterias
* Evaluate
  + Assess value
* Gantt Chart
  + Chart laying out schedule
* Mediation
  + Intermediate agreement
* Negotiation
  + arrangement of the terms of an agreement.
* Norms
  + Guides to accepted behaviour
* Open-Ended
  + unrestricted
* Protocol
  + accepted behavior
* Storming
  + Phase with conflict.
* Synergy
  + A unit stronger than an individual
* Virtual Team
  + Group using electronic communication to collaborate
* Define a Problem
  + Identify a problem
  + Validate the problem
    - Who says it is a problem?
    - Needs and wants
    - Prior Solutions
    - Justify the problem
      * Is the problem worth solving?
  + Create design requirements
  + Criteria and constraints
  + Project Proposal
* Generate Concepts
  + Brainstorm possible solutions
    - Creating ideas, solving problems as a group
      * Rules
        + No criticism
        + Work for quantity
        + Welcome piling on
        + Allow free for all
  + Research
  + Decision Matrix
    - To choose best concept
  + Design Proposal
* Develop a Solution
  + Consider design validity
    - Function
      * Do it do what it needs to do?
    - Aesthetics
      * Does it look good?
    - Ergonomics
      * Can people safely interact with it?
    - Safety
    - Cost
      * It it too expensive?
    - Environment
      * Does it cause pollution?
    - Durability
      * Does it break easily?
    - Ease of Maintenance
      * Is it too difficult to repair?
  + Create detailed design solution
  + Technical Drawings
    - drawing that is used to show the material, size, and shape of a product for manufacturing purposes, in 2D
    - multiview/orthographic
      * Uses as many views as needed
        + No views should be identical
        + Usually has top front side
        + One view for uniform thickness, and all dimensions can fit
        + Two views for varying depth with symmetry
        + Front view

Most natural position

Largest width

Least hidden lines

Best shows shape

* + - * + Section view

Shows hidden interior

Has no hidden lines

Full section

cuts so half is visible

Half section

Cuts so a quarter is visible

Off section

At no set ratio

Cutting plane line indicating where it’s cut, with arrows pointing to part that is kept

Section lines indicates where cutting plane line intersects object

* + - * + Auxiliary view

Shows a slanted side, not parallel to any of the views in the multiview

* + - * + Detail view

Shows close up of specific part

* + - * Width is consistent between front and top views
      * Height is consistent between front and side views
      * Depth is consistent between top and side views
      * Projection Plane
        + Plane on which the view of the object is projected and drawn.
        + imagined to exist between the object and observer.
      * Line Convention
        + Standardization of lines used on technical drawings by weight and style
        + Weight

Width, thickness

* + - * + Object Line

Represents outline of object (solid line)

* + - * + Hidden Line

Represents an edge that is not visible (dotted line)

* + - * + Center Mark

Indicates center of circular shapes

* + - * + Centerline Bisector

Indicates central axis of cylindrical shapes

* + - * + Leader Line

Used to dimension radius/diameter of circles

* + - * + Dimension Line

Lines with arrowheads to indicate dimensions

* + - * + Extension Line

Used to identify the extent of a dimension

* + - * + Miter Line

45o line from corner from front view used to project lines

* + - * + Short break line

Breaks object to show something hidden

* + - * + Long break line

Cut part of drawing that’s repetitive

* Construct and Test a Prototype
  + Construct a testable prototype
  + Plan prototype testing
    - Performance
      * Does it perform as intended?
    - Usability
      * Can it easily be used?
    - Durability
      * Will it easily break?
  + Test prototype and collect data
  + Analyze test data
    - Look for necessary revisions
  + Test Report
* Evaluate the Solution
  + Reflect on design and recommend improvements
  + revise the solution (Return to prior steps if necessary)
  + Revise design documents
  + Project Recommendations
* Present the Solution
  + Document the project with a portfolio of work
  + Present the project with a formal presentation
  + Manufacture
    - make something on a large scale using machinery

**Pictorial Sketches**

* Sketch depicting an object’s height, width, and depth in a single view
* Construction Line
  + Thin lines that guides while sketching
* Tonal Shading
  + shading used to enhance appearance
* Isometric
  + all three drawing axes form equal angles of 120o with the plane of projection.
  + 3 types of lines
    - depth
      * Line along the 30°/-150° axis (slanting positive slope)
    - Width
      * Line along the 150°/-30° axis (slanting negative slope)
    - Height
      * Line along the 90°/-90° axis (vertical one)
* Perspective
  + vanishing points are used to provide depth and distortion
    - Vanishing Point
      * point located on the horizon, where parallel edges of an object appear to meet
  + One point
    - Horizontal
      * Represent width
    - Vertical
      * Represent height
    - Diagonal to Vanishing Point
      * Represent depth
  + Two point
    - receding lines meet at vanishing points on the horizon
    - most natural of all pictorial drawings.
    - Vertical
      * Represents height
    - Diagonal to either left/right of vanishing point
      * Represent width/depth respectively
  + Oblique
    - Flat front with depth lines receding at a selected angle, usually 45o
    - Cavalier
      * Used true depth
    - Cabinet
      * Uses half depth
      * Most realistic
    - General
      * Depth of any sizes
    - Projection Plane
      * imaginary plane where the view of an object is projected and drawn.
      * imagined to exist between the object and the observer.

**CAD**

* Using a computer to assist in the process and communication of part design for drafting
* Autodesk Inventor
* Solid modeling
  + represents the volume of an object, not just its lines and surfaces.
* Wireframe Modeling
  + represents the lines and surfaces of a design.
* Additive Modeling
  + each component is created individually then combined
* Subtractive Modeling
  + a design is created by removing parts from a block larger than the final design
* Fillet
  + A rounded interior blend between two surfaces.
* Round
  + An outside radius applied to corners.
* Chamfer
  + A small angled surface formed between two surfaces.
* Assembly
  + parts that fit together to form a self-contained unit.
  + Mate -dont think weird 
    - Things made to touch each other
    - 3 degrees of freedom remain
  + Flush -not toilet 
    - Surfaces aligned at a height
    - 3 degrees of freedom remain
  + Angle 
    - set angle between surfaces.
  + Insert 
    - Places a cylindrical object into a cylindrical hole.
    - Only one rotational freedom remain
  + Tangent 
    - curved object touches a flat surface at one point
  + Point 
    - for spherical shapes or on an edge (cylindrical objects)
    - constrain two curved surfaces together.
  + Base Component
    - The first part placed into an assembly
    - Is grounded
  + Grounded Component -u
    - has 0 degrees of freedom (cannot move).
      * Freedoms
        + Translating (move without rotating in a specific direction) and rotating (spin circularly around axis) on x, y, z axises
* Title blocks
  + Balloons
    - A circled number identifying each part shown in an assembly drawing.
  + Documentation
    - The documents that are required as evidence or proof
    - Drawings or printed information containing instructions for assembling, installing, operating, and servicing product
  + exploded Assembly
    - parts are moved out of position along an axis so that each part is visible.
  + Parts List
    - A list of parts in a project.
  + Title Block
    - table located in the bottom right-hand corner of a technical drawing that identifies information (designer, title, date, scale, company, logo) that is not given on the drawing itself.
  + Annotation
    - Connected to features on the views of the drawing
  + General Note
    - Notes separate from the views
    - relates to the entire drawing.
  + Axis
    - Line that something rotates around
    - Center of a symmetry
  + Coil
    - Coil a profile around axis
  + Sweep
    - Takes a profile and make it follow path
  + Profile
    - Outline of object from a side
  + Work plane
    - Plane to help add additional features

**Dimensioning**

* Unidirectional
  + Dimensions are in 1 orientation
* Aligned
  + Orientation of dimensions based on orientation of dimension line
* datum/baseline
  + Dimensions originate from a baseline
* Chain
  + Dimensions start where the previous ends
* Don’t duplicate dimensions
* Don’t dimension hidden lines
* Keep dimensions between views
* Don’t cross dimension or extension lines
* Holes need a size, and 2 location dimensions (distance from a feature to another) from their center
* Circles are dimensioned by diameter ⌀
* Arcs are dimensioned by radius
* Parametric modeling
  + Parameter
    - Fixed quantity
  + Parameters define size
  + Sizes are in relation to other sizes
* Tolerance
  + Permissible variation
  + Limit dimension
    - Shows 2 numbers
    - Largest and smallest possible boundaries
  + Bilateral tolerance
    - Tolerance in both direction of specified dimension
    - Shows +/-
  + Unilateral tolerance
    - Tolerance in one direction of specified dimension
    - Shows + and -, and one is a 0
  + Clearance fit
    - Gap between mating parts -be clean thoughts plz
  + Interference
    - Overlap of parts
  + Transition fit
    - Mating parts sometimes clearance, sometimes interference
  + Allowance
    - Tightest fit of 2 mating parts
    - MMC internal - MMC external (minimal clearance)
      * (Largest object minus smallest slot)

**Statistics**

* Collection of methods for planning experiments, obtaining data, organizing, summarizing, presenting, analyzing, interpreting, and drawing conclusions based on data
* Assessment
  + An evaluation technique for technology that requires analyzing benefits and risks, understand the trade-offs and them determining the best action to that in order to ensure that the desired positive outcomes outweigh the negative consequences.
* Research
  + The study of materials to establish facts and draw new conclusions.
* Data
  + Info collected for analysis
* Data Set
  + A group of individual values
* Mean
  + average
* Median
  + middle term or mean of the middle two terms of data put in order
* Mode
  + value occuring most frequently in data
* Range
  + difference between the highest and lowest values in the data
* Dot plot (Line plot)
  + method of displaying a distribution of data, where values are shown as a dot or mark above a number line
* Histogram
  + graph of vertical bars representing the frequency a value is present in data
* Class Interval
  + group of values used to analyze the distribution of data
* Frequency
  + rate something occurs over in a sample/period
* Normal Distribution
  + distribution of data that is symmetrical when graphed
* Standard deviation
  + Average of distance from data points to mean
  + Find square root of the square of the difference between mean and sum of data when divided by the total amount of data points (minus 1 if for sample)
  + Empirical rule
    - In standard distribution
    - 68% of data points are 1 standard deviation away from mean
    - 95% of data points are 2 standard deviations away from mean
    - 99.7% of data points are 3 standard deviations away from mean

**Design**

* Aesthetic
  + Concerned with beauty
  + pleasing appearance.
* Elements of Design
  + Components used in the creation of a design, forms principle
  + Point
    - Most basic element
  + Line
    - Set of collinear points
    - Sets boundary
  + Shape
    - Enclosed area
  + Form
    - object
  + Color
  + value (tone)
    - Dark, light
  + Space
    - openness
  + Texture
    - Repeated pattern
* Principles of Design
  + Concepts that surround a design, made of elements
  + Balance
    - different elements are equal or in the correct proportions.
    - Symmetry
      * Identical on both sides
    - asymmetry
      * Visually balanced, not necessarily identical
    - Radial
      * Balance circularly around an axis
    - Horizontal Balance
      * Balance on left and right
    - Vertical balance
      * Balance on top and bottom
  + Rhythm
    - recurring sequence of events or actions
    - Regular
      * Repeated at same interval
    - Random
      * Repeated at irregular intervals
    - Gradated
      * Detail increases or decreases with each repetition
    - Graduated
      * Element gets closer or farther with each repetition
  + Emphasis
    - Special prominence given to something
  + Proportion
    - Size, amount of something in relation to something else
  + unity (harmony)
    - Being uniform
  + Economy
    - Saving material
  + Contrast
    - different from something
    - Enhancing appearance by different colors or textures
* Gestalt
  + principle that states that a person sees objects in their entirety before focusing on their individual parts
* Variety
  + A thing that differs from others in the same class

**Reverse Engineering**

* Taking something apart, analyze it to understand function, improve it
* Visual analysis
  + Analyze design to understand why elements and principles are incorporated
* Functional analysis
  + Analyze components to find how design works
  + Black box model
    - Analyze input and output
* Structural analysis
  + Analyze construction to determine durability

**Holes**

* Blind
  + ↧x, x= depth
  + Doesn’t cut through whole shape
* Through
  + Øx THRU, x=diameter
  + Cuts through whole shape
* Counterbore
  + ப indicates diameter is for top portion
  + Cylindrical top and bottom of different diameters
* Countersink
  + V indicates diameter is for top portion
  + X followed by the degree of the taper
  + Tapered cylindrical top with cylindrical bottom of different diameter
* Tapped
  + x-UNC, where x = threads per in
  + Hole with threads

**Ethics**

* Attorney general
  + Main legal officer of a state
* EPA
  + Concerns with environmental impact
* OSHA
  + Concerns about worker safety
* Ecosystem
  + Community and their environment
* Ethics
  + Accepted principles of contact
* Product lifecycle
  + Lifecycle of a product
  + extract/raise
    - Gather raw material for processing
  + Process
    - Make raw material into a usable material
  + Manufacturing
    - Make processed materials into product
  + use/repair
    - Use product, refurbish when needed
  + disposed/recycle
    - To reuse reusable parts, dispose of rest
  + Refurbish
    - Renovate, redecorate
  + Byproduct
    - Side effect from doing something
  + Carcinogen
    - Substance increasing risk for cancer
  + Ergonomics
    - Study of design to ensure safe interactions
    - Residue
      * Remains after main part is used/gone

**Solids**

* Density = mass / volume
* Surface area
  + Sum of exterior surfaces
* Center of gravity
  + Average location of weight
* Centroid
  + Center of solid

**Precision and Accuracy**

* Precision
  + Ability to repeat task
* Accuracy
  + Ability to get close to what’s accurate

<https://drive.google.com/file/d/1vU0XAF6UPuxaQcYJA8jzh6wW-tpVjZb7/view?usp=sharing> this one has pictures