Semester in Review

24-370 - Spring 2011

Professor Steve Collins

Reminders and Announcements

- Project 3 Reports due May 5th at midnight
- HW 9… cancelled
- Course Evaluations
  - How administration makes course decisions
    - Consider the value (learning/work)
  - The only way my teaching is evaluated
  - Additional written feedback greatly appreciated
    - Include anything you like, regardless of questions

What you have learned

- Technical basis
  - Analytical and numerical analyses
  - Basic optimization techniques
- Practical knowledge
  - Useful parts, materials, sources, and tools
  - Design processes and techniques (iteration)
- Intuition for machine and robot design
  - Hands-on experience
  - Useful creativity

What you have learned

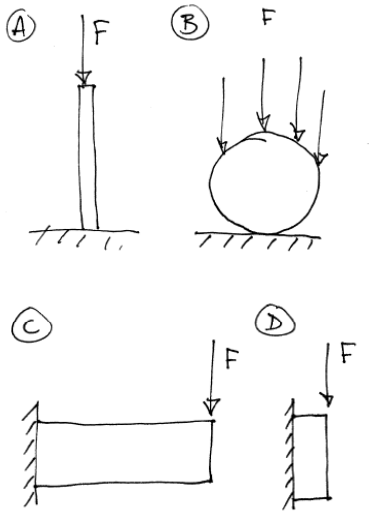
- Sketching
  - Quick concept generation
  - Detailed spatial communication
- Simple models
  - Simplest abstraction that captures phenomena
- Check yourself:
  - What is the simplest model of a wrench?

What you have learned

- CAD modeling (SolidWorks)
  - Creating parts and features
  - Assembling components
- Creating engineering drawings (SolidWorks)
  - Orthographic and isometric projections
  - Dimensioning
- CAD analysis (SolidWorks)
  - Stress analysis in components
  - Stress analysis in assemblies, e.g. contact
  - (thermal analysis…)

What you have learned

- Failure analysis
  - Simple stresses
  - Bending stresses
  - Contact stresses
  - Buckling
  - Fatigue
  - Ductile vs. brittle failure
- Check yourself:
  - Fatigue analysis?
  - Improved designs?



What you have learned

- Material selection
  - Key mechanical properties
    - E.g. ultimate & yield strength, density, elasticity
  - Available materials
    - E.g. 7075 Aluminum, 440C Stainless Steel
  - Where to find these
    - Selection charts, Matweb
- Check yourself:
  - Material for small, complex, high-strength part?
  - Material for large, simple, high-stiffness part?

What you have learned

- Principles for assembly
  - Joints only where necessary for motion, assembly
  - Tolerances and stacking
  - Perfectly constrained solutions
- Types of assembly elements
  - Rigid joints: fasteners, welds, clamps
  - Articulating joints: plain, ball and roller bearings
- Check yourself:
  - Rigid joint: Normal, friction or shear loading?
  - Articulation: Linear or rotational joint?

What you have learned

- Kinematics of assemblies
  - Spatial position through geometry
- Kinetics of assemblies
  - Gearing and torque, velocity
- Dynamics of assemblies
  - Forces for acceleration
  - Forces for rotational acceleration (centri
- Check yourself:
  - Dynamic loading on a cam shaft?
  - Output torque vs. gear ratio R?

What you have learned

- Catalog component selection
  - Motivations
  - Components available and prominent sources
  - Key properties and methods of analysis
- Check yourself:
  - Where would you look for a: Ball bearing? Small gear set? Electric motor? Timing belt?
  - Gear analysis: property most influences strength?
  - Wire rope: minimum drum diameter estimate?
  - What properties are important in encoders?

What you have learned

- Electric motor analysis
  - Key properties
  - Underlying dynamical models
  - Simple steady-state methods
  - Numerical simulation in Matlab
- Check yourself:
  - What are key properties for: Powering tasks? Torque-production tasks?
  - How do induction and rotor dynamics differ?
  - Why does back-EMF matter?

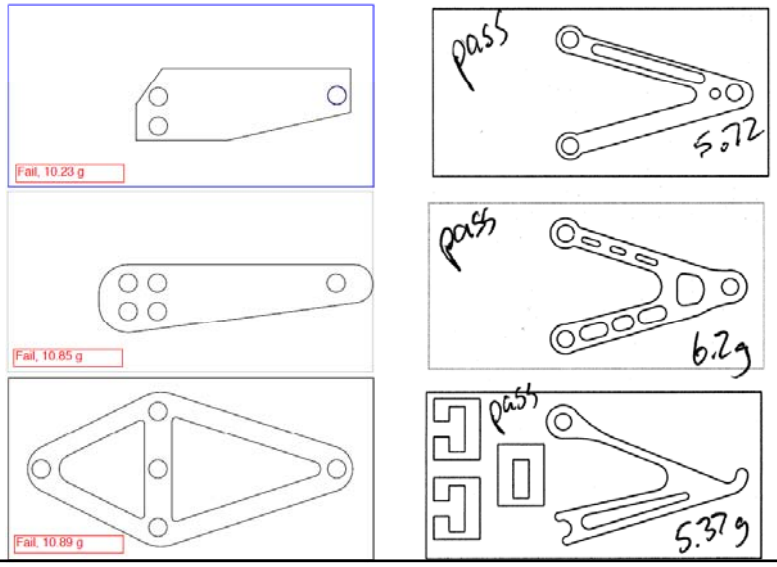
What you have learned

- Design for manufacture
  - Common processes and their properties
  - Selection process
- Cost analysis
  - Simple models of manufacturing cost
  - Tools for estimation
- Check yourself:
  - When might you use injection molding?
  - When should you use sand casting?
  - How would you estimate the cost of a seam?

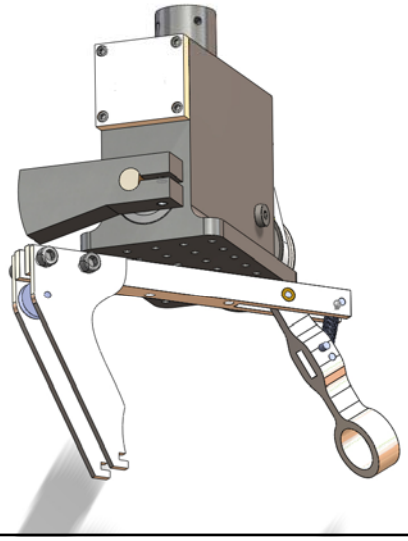
What you have learned

- Design for environment
  - Manufacturing impacts
  - Life Cycle Analysis tools
- Ethics in engineering
  - General principles for ethical behaviour
  - ASME ethics code
- Check yourself:
  - How could ethanol use cause toxic waste?
  - Can you currently consult on biomedical projects?

What you have learned



What you have learned



What you have learned

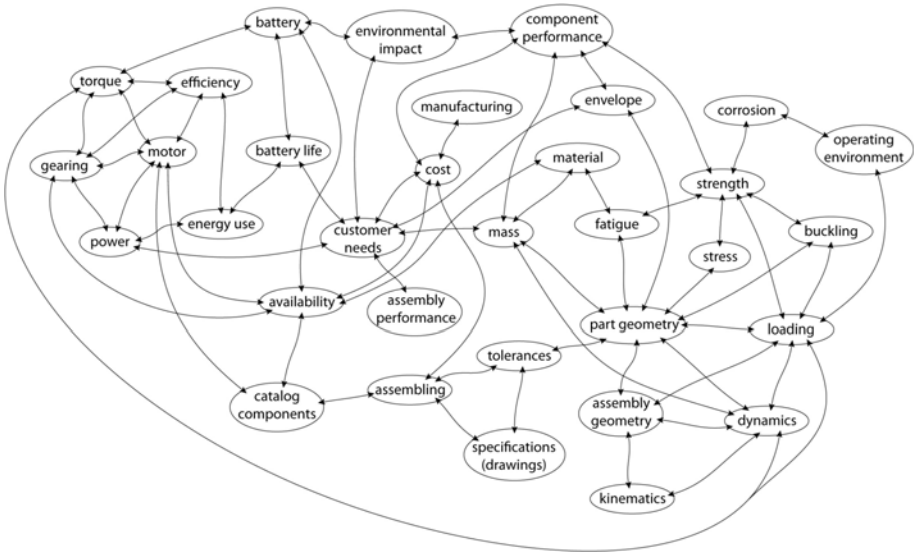
What you have learned

- Photos of project 2 testing: we had a lot of fun learning it :D

What you have learned

- Technical basis
  - Analytical and numerical analyses
  - Basic optimization techniques
- Practical knowledge
  - Useful parts, materials, sources, and tools
  - Design processes and techniques (iteration)
- Intuition for machine and robot design
  - Hands-on experience
  - Useful creativity

What you have learned



What you will learn next: EDII

- Product design research
  - Market research
  - Evaluating customer needs
- Design theories and principles
  - Design process
  - Project planning
  - Concept generation
  - Design optimization
- Open-ended problem solving
- Communication of product design

What I have learned

- My first undergraduate course
  - Many unexpected things…
  - Hands-on, exercise, apply, repeat
  - Goodness, teaching is hard!
- You have helped make this course stronger
- I'm impressed with your designs, and progress
- I'm proud of you
- Thank you