Elec 4309 Senior Design

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Aug. 22, 2017

Student Honor Code

- Students will not give or receive aid during examinations.
- Students will not use any prohibited electronic devices during examinations.
- Students will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading.
- Students will uphold the spirit and letter of the Honor Code and they will take an active role to ensure that others uphold the Honor Code and if they observe violations of the Honor Code they must report violations to their Department Chair.
- The Faculty of the College will do its part to ensure its confidence in the honor of its students. Faculty must ensure that precautions are in place to prevent the forms of dishonesty mentioned above. Faculty will also avoid, as far as practical, academic procedures that create temptations to violate the Honor Code. Faculty alone has the right and obligation to set academic requirements. However, the students and faculty will work together to establish optimal conditions for honorable academic work.

Violations of the Honor Code

- Copying from another’s examination paper or allowing another to copy from one’s own paper.
- Plagiarism in any shape or form. Plagiarism is defined as the use, without giving reasonable and appropriate credit to or acknowledging the author or source, of another person's original work, whether such work is made up of code, formulas, ideas, language, research, strategies, writing or other form(s).
- Giving or receiving unpermitted aid either in person or via electronic devices.
- Engaging in unauthorized collaboration on academic assignments or examinations.
- Representing as one’s own work the work of another.

Penalties for Violating the Honor Code

- Most student disciplinary cases have involved Honor Code violations.
- Of these, most cases arise when a student submits another's work as his or her own, gives or receives unpermitted aid, or engages in unauthorized collaboration.
- If a violation occurs during a quiz or on a homework assignment, the student will receive a zero for that quiz or assignment.
- If a violation occurs on an examination, the student will receive a failing grade for the course.
- The standard penalty for a first offense may include suspension from the College of Engineering and Applied Science for a severe infraction of the Honor Code.
- The penalty for a second violation will be expulsion from the College of Engineering and Applied Science.

Engineering Design

- Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision making process in which the basic sciences and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, and testing….

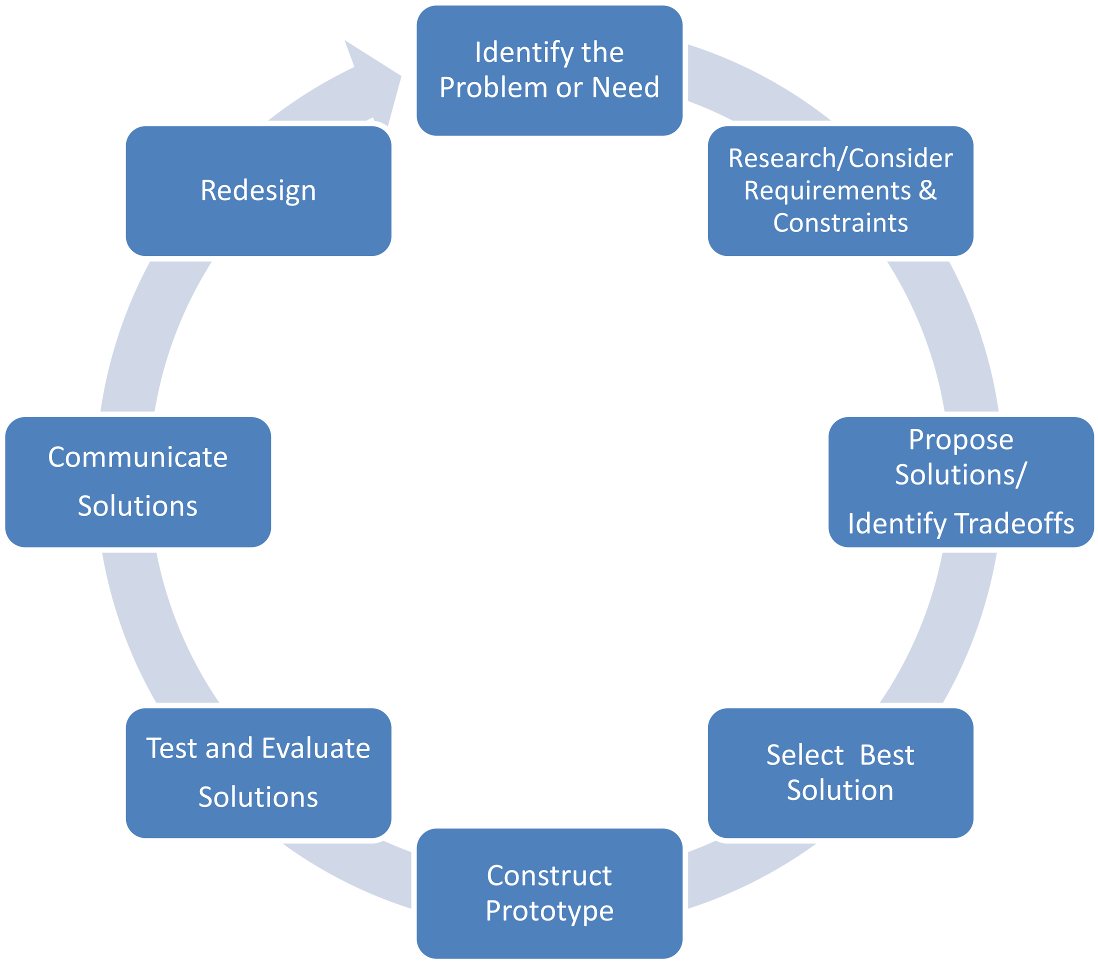
Engineering Design Process

- Creative process
- Problem solving – the big picture
- No single "correct" solution
- Technical aspects only small part

The “General” Design Process

1. Identify the problem
2. Define the working criteria/goals
3. Research and gather data
4. Brainstorm ideas
5. Analyze potential solutions
6. Develop and test models
7. Make decision
8. Communicate decision
9. Implement and commercialize decision
10. Perform post-implementation review

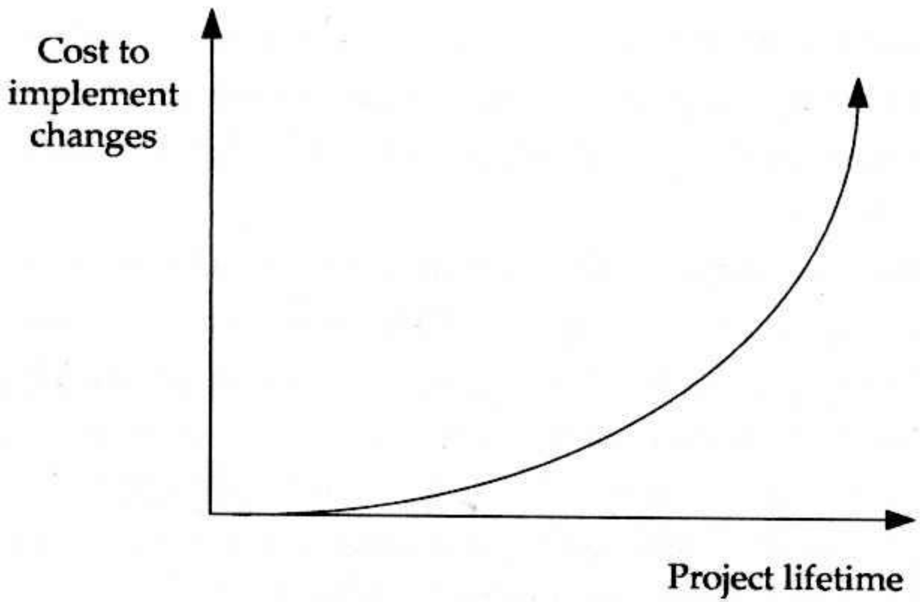
Or Pictorically



Elements of the Design Process

- Problem Identification
- Research Phase
- Requirements Specification
- Concept Generation
- Design Phase
- Prototyping Phase
- System Integration
- Maintenance Phase

Cost of Design Changes



- Costs increase exponentially as the project lifetime increases

Needs Identification

- What is the Problem?

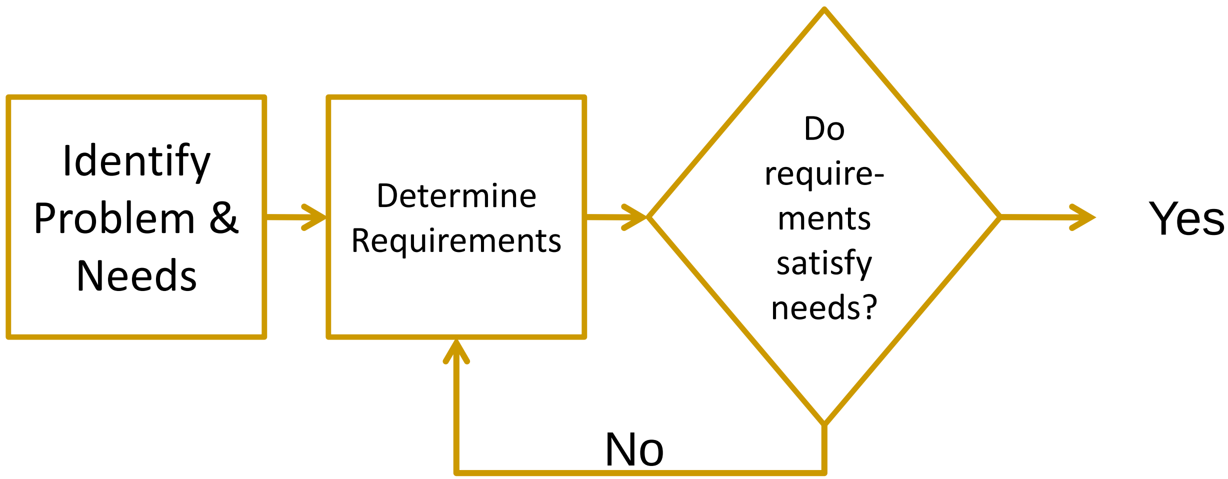
1. Collect information
2. Interpret information
3. Organize needs hierarchy
4. Determine relative importance of needs
5. Review outcomes and process

UK Defence Innovation Initiative

Support the development of futuristic technologies and smart solutions, such as:

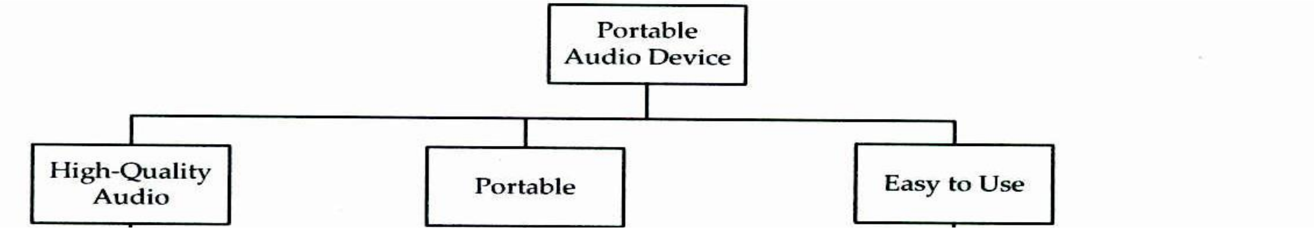
- surveillance drones inspired by dragonflies,
- laser weapons,
- mobile robots that can inspect incidents involving chemical materials,
- sensors that use gravity to survey underground structures in minutes, and
- virtual reality helmets to practice calling in simulated air strikes.

Problem Identification and Requirements Specification



A prescriptive design process for problem identification and requirements selection

Example of Needs Hierarchy



Objective tree for a Portable Audio Device to be Used by Runners

Problem Statement

- Example:
  - Need: Drivers have difficulty seeing obstructions in all directions
  - Objective: design system to avoid accidents

Requirements Specifications

- Identifies requirements design must satisfy for success

1. Marketing requirements
   - Customer needs
2. Engineering requirements
   - Applies to technical aspects
   - Performance requirements

Properties of Engineering Requirements

1. Abstract – what, not how

2. Unambiguous – unique and specific
   - Unlike marketing requirements

3. Traceable – satisfy need?

4. Verifiable – test/measure

Example Engineering Requirements

- Performance and Functionality
  - Will identify skin lesions with a 90% accuracy
  - Should be able to measure within 1mm

- Reliability
  - Operational 99.9% of the time
  - MTBF of 10 years

- Energy
  - Average power consumption of 2 watts
  - Peak current draw of 1 amp

Properties of Requirements Specifications

1. Normalized (orthogonal) set
2. Complete set
3. Consistent
4. Bounded
5. Granular – system vs. component
6. Modifiable

✓ *From IEEE Std. 1233-1998*

Constraints

- Economic
- Environmental
- Ethical and Legal
- Health and Safety
- Manufacturability
- Political and Social – FDA, language?
- Sustainability

Standards

- Examples – RS-232, TCP/IP, USB
- Other Types:
  - Safety
  - Testing
  - Reliability
  - Communications
  - Documentation
  - Programming Languages

Concept Generation and Evaluation

- Explore many solutions
  - Brainstorm
- Creativity
  - Development of new ideas
- Innovation
  - Bringing creative ideas to reality
- Select the best solution
  - Based on needs and constraints

Design Considerations

- WORST CASE DESIGN
  - Component variation
  - Environmental conditions
  - Use computer simulations

Design Methodologies: Top-Down

- Also called “functional decomposition”
- Implementation details considered only at the lowest level
- Top-down design, is not so clean and linear in practice
- Often implementation level commitments are made at high levels in the design process

Design Methodologies

CASE-BASED:

- Research a specific, similar design case study
- Model your process on that

INCREMENTAL REDESIGN:

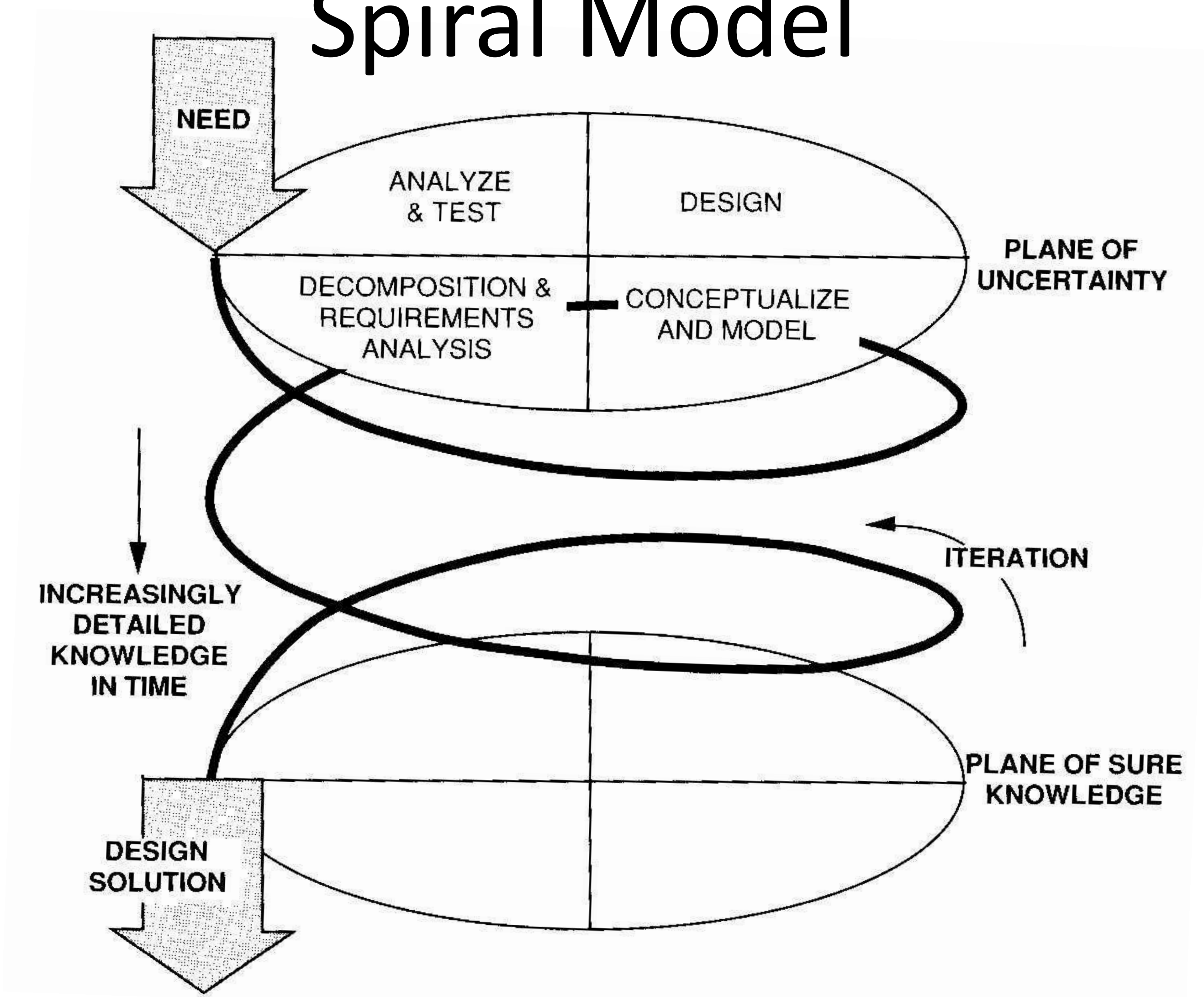
- Find an existing design and "unravel" the design from the bottom up
- Modify as required
- Detailed and least global aspects of the design are explored and redesigned, if necessary, first

Design Methodologies

ITERATIVE REFINEMENT:

- An iterative top-down approach
- First a rough, approximate and general design is completed
- Then we do it finer, more exact and more specific
- This process continues iteratively until the complete detail design in done

Spiral Model



Design Methodologies

BOTTOM-UP DESIGN:

- Opposite of top-down
- Start at the bottom with detail design
- To do this, you must have some idea of where you are going. So, often this becomes...

HYBRID DESIGN:

- Combines aspects of both top-down and bottom-up
- More practical design approach then pure top-down
- Start with a top-down approach, but have feedback from the bottom

Design Methodologies

"EXPLORER" METHOD:

- Typically used for new design ideas or research. It is useful in initial design and specification stages, and is often used when in "unfamiliar territory":

  1) Move in some direction; e.g. toward the library, telephone, domain expert's office, etc.
  2) Look at what you find there.
  3) Record what you find in your notebook.
  4) Analyze findings in terms of where you want to be.
  5) Use results of analysis to choose next direction.
  6) Back to 1) and continue exploring

Design Considerations

The design of a component or system may be influenced by a number of requirements. If a requirement affects design, it is called a design consideration. For example, if the ability to carry large loads without failure is important, we say that strength is a design consideration. Most product development projects involve a number of design considerations:

- Strength/stress
- Distortion/stiffness
- Wear
- Corrosion
- Safety
- Reliability
- Friction
- Usability/utility
- Power Profile
- Cost
- Processing requirements
- Weight
- Life
- Noise
- Aesthetic considerations
- Shape
- Size
- Scrapping/recyclability
- Thermal properties
- Surface finish
- Lubrication
- Marketability
- Maintenance
- Volume
- Liability

Design Teams

- Engineering projects require diverse skills
- This creates a need for group (team) work

- Select members based on skills:
  1. Technical
  2. Problem-solving
  3. Interpersonal

Design Teams

- Develop decision making guidelines:

  1. Decision by authority (leader)
  2. Expert Member
  3. Average member opinion
  4. Majority
  5. Consensus

Design Teams

- Teams that spend time together tend to be successful teams
- Respect each other

1. Listen actively
2. Consider your response to others
3. Constructively criticize ideas, not people
4. Respect those not present
5. Communicate your ideas effectively
6. Manage conflict constructively

Take 15 Minutes to Interact with colleagues in class to form teams for Projects

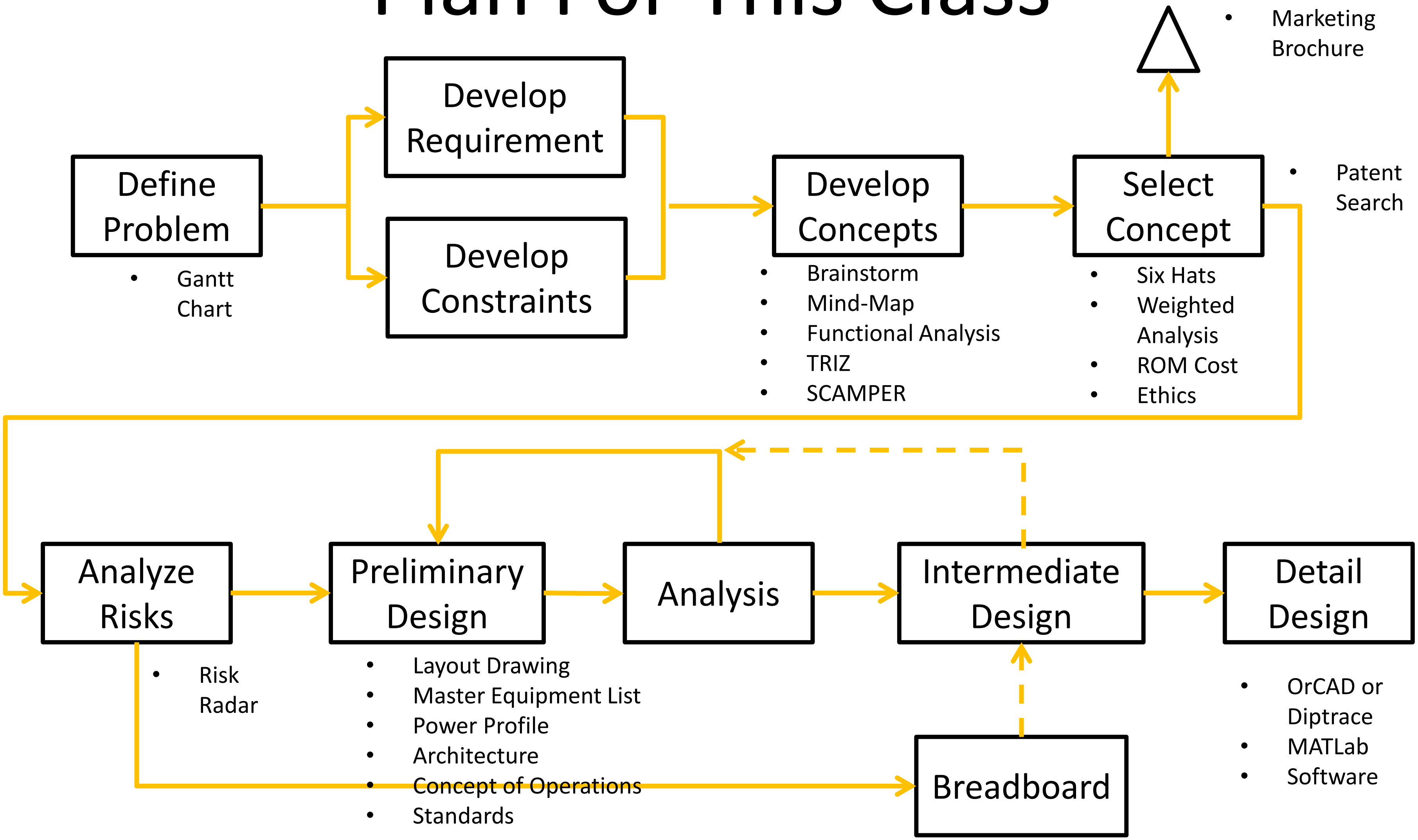
Design Teams

- Hold effective meetings

  1. Have an agenda
  2. Show up prepared
  3. Pay attention
  4. Schedule time and place of next meeting
  5. Summarize

- Assign tasks and responsibilities

Plan For This Class



Class Schedule

AUGUST 2017

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

SEPTEMBER 2017

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Class Schedule

OCTOBER 2017

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

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NOVEMBER 2017

SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	Fall Break 22	23	24	25
26	27	28	29	30		

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Class Schedule

DECEMBER 2017						
SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Finals Week

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My Contact Information

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  - Office Hours: T/Th (05:30 pm – 06:30 pm)
- Contact Information
  - Email: wendell.chun@gmail.com
  - Email: wendell.chun@ucdenver.edu
  - Cell Phone: 720-877-1184
- Class
  - Tuesday: NC-2408 (06:30 pm – 07:45 pm)
  - Thursday: NC-2408 (06:30 pm – 07:45 pm)

Take Aways from Class

- Innovation & creativity in Design
- Design Process (problem, requirements, constraints, brainstorming, concept selection, architecture, Concept of Operations, Risk Management)
- DeMarco Model & Hatley/Pirbhai Model
- Data Flow Diagrams
- Patents, Ethics, and Standards