# The Wipe-the-Slate-Clean Approach to Systematic Change

**Rob A. Rutenbar**
**Carnegie Mellon University**

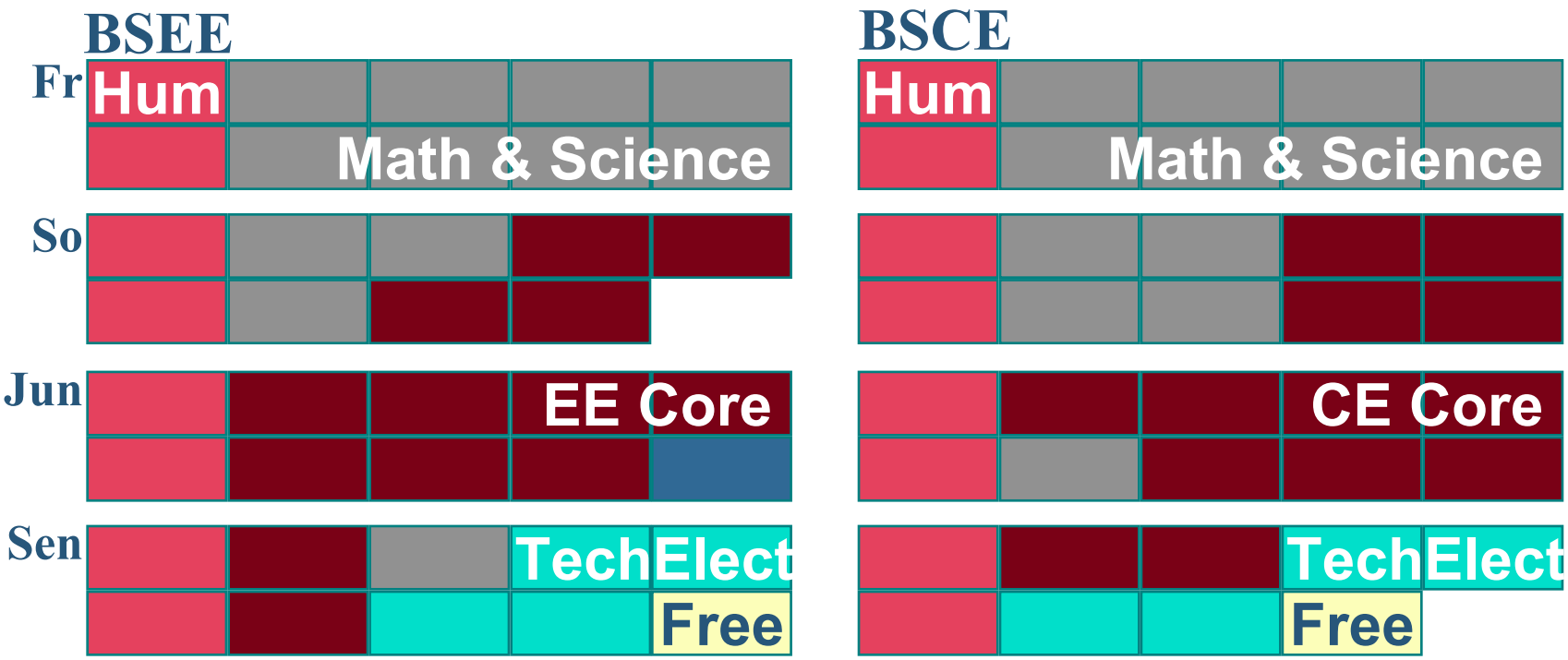
© R. Rutenbar, CMU 1997 

# Outline

- **Quick review of CMU curricula development**
  - Why we changed
  - What we changed
- **Wipe-the-Slate-Clean as an *approach***
  - Timeline:  how it unfolded
  - Strategy & tactics:  how we did it
- **Implementation issues**
  - Accreditation
  - Measurement

# CMU ECE Starting Point: Pre-1991

- **Separate, accredited EE and CE BS degrees**
  - ~5x8 courses; common freshman year and some core
  - 40% pursued BSEE, 50% BSCE, 10% double majored



# Why Change?

- **Information explosion**
  - More topics to teach, less time to teach them
  - Mediocre K-12 prep just exacerbates this
- **Retention, diversity**
  - Some give up before they ever see real engineering
  - Not doing well on recruiting diverse student body
- **Breadth**
  - Tough to do broad, cross disciplinary studies
  - Rigid, inflexible curricula stifling innovation
- **Mindset**
  - Students too often just surviving classes--no fun

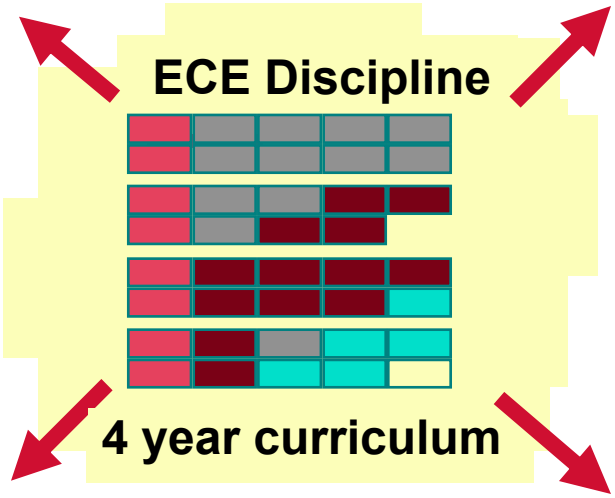
# Issue: Poorly Integrated Topics

- **Problems**
  - Teach math and science early, engineering much later
  - Motivation and context lacking; retention weak
- **Solution**
  - Teach engineering early (across college of engineering)
  - Math & science as co-requisites

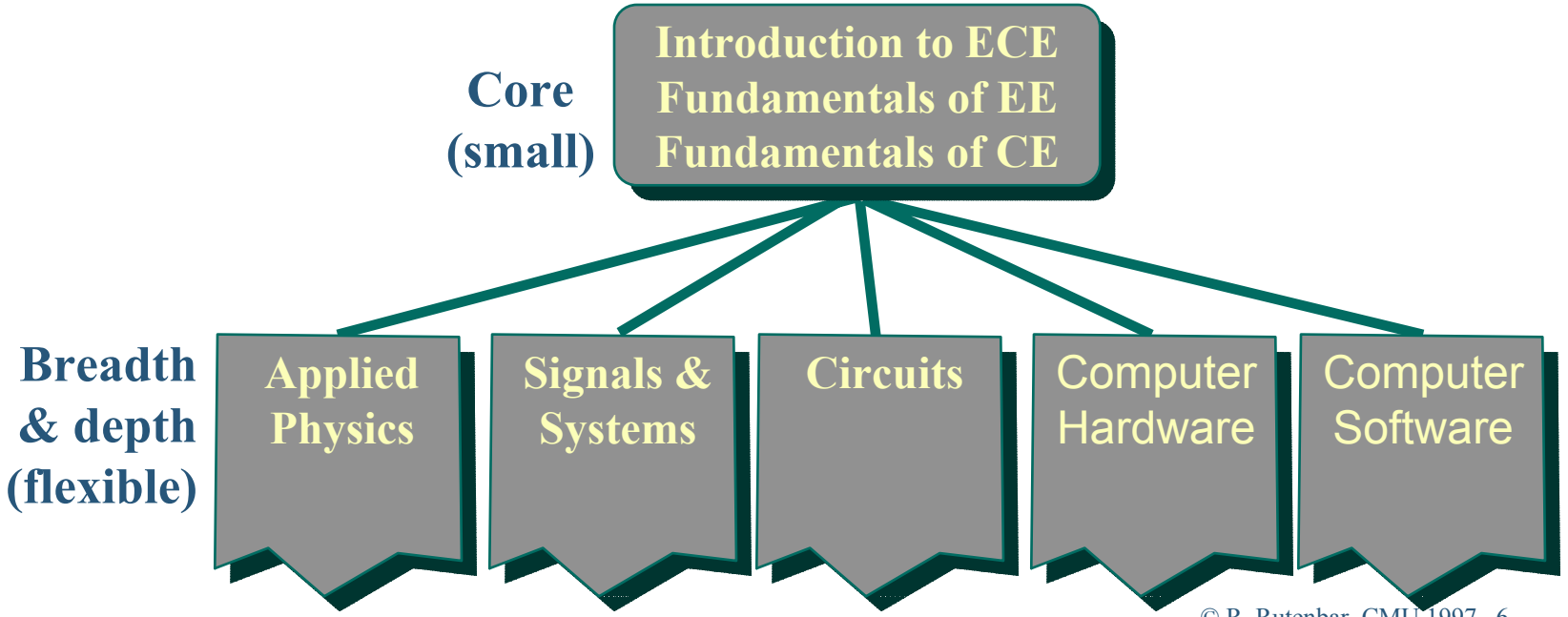
**Freshman year**

| | | | | |
|---|---|---|---|---|
| Fall | Humanities | Intro ECE | Calculus I | Programming |
| Spring | Humanities | Intro Engin | Calculus II | Physics I |

# Issue : Explosion of Discipline




- **Problem**
  - Set of “essential” topics expanding
- **Solution**
  - Small core + flexible breadth/depth




© R. Rutenbar, CMU 1997 

# Issue: Different Skills, Aspirations

- **Solution**
  - Great flexibility in choice of ECE courses & free electives

4 courses/semester X 8 semesters

| | | | | |
|---|---|---|---|---|
| Fresh | Humanities | Intro ECE | Calculus I | Programming |
| | Humanities | Intro Engin | Calculus II | Physics I |
| Soph | Humanities | Fund of EE | Linear Alg | Physics II |
| | Humanities | Fund of CE | Discrete Math | Free |
| Junior | Humanities | ECE Breadth 1 | Breadth 2 | Breadth 3 |
| | Humanities | Depth | Coverage | Free |
| Senior | Humanities | Design | Free | Free |
| | Humanities | Free | Free | Free |

© R. Rutenbar, CMU 1997 

# New Curriculum: Big Ideas

- Engineering in Freshman year (2 courses)
- Small required ECE core (3 courses)
- Based more on topical areas than specific courses
- ECE = Breadth + depth + design + coverage
- Free electives (almost 1 year)
- Single, integrated BSECE degree

# Wipe-the-Slate-Clean: Process

- **Strategy: *Nothing is sacred in the curriculum***
  - Willing to change core courses
  - Willing to change requirements, sequences
  - Willing to change advising structures
  - Willing to change accreditation posture

- **Starting point: WSC Committee**
  - Diverse subset of departmental faculty (11 people)
  - All technical & teaching areas represented
  - All philosophical positions represented (traditional, radical...)
  - No preconceived limits

# Aside: Impediments to Change

- **From Chang-Lin Tien, chancellor, U. C. Berkeley, from his 1992 Woodruff Lecture at Ga. Tech.:**
  - Programmatic argument

    "We already have more course req's in engineering than in any other major, and each is *essential*."
  - Protectionist argument

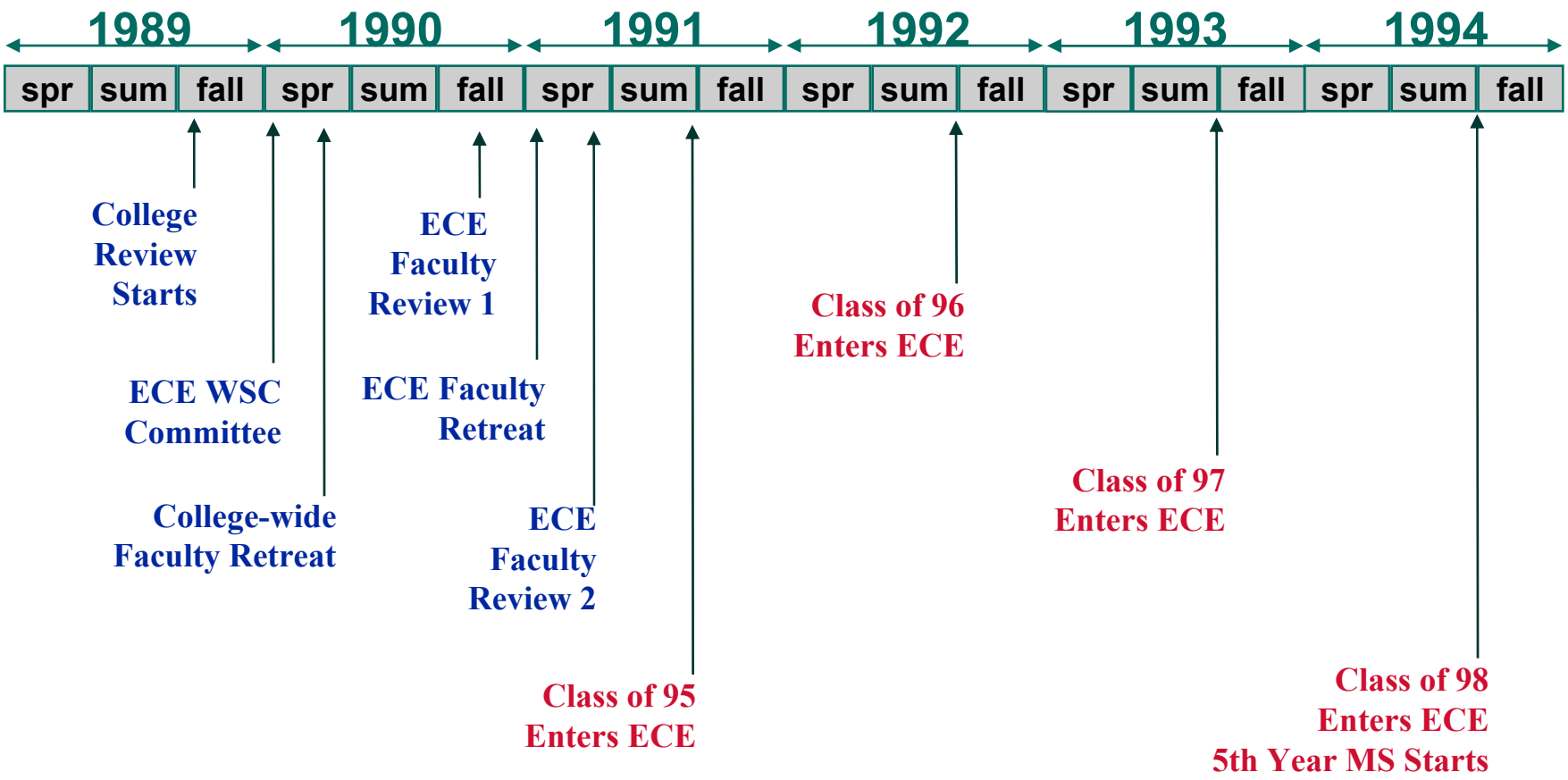
    "*My* academic field has been *terribly* important in the 30 years I have been teaching. We cannot afford to give up classes in this field."
  - Resources argument

    "...funding is tighter than ever. How can we pay for *new* programs when we can hardly maintain those we have?"

- **We didn't succumb to any of these standard objections**

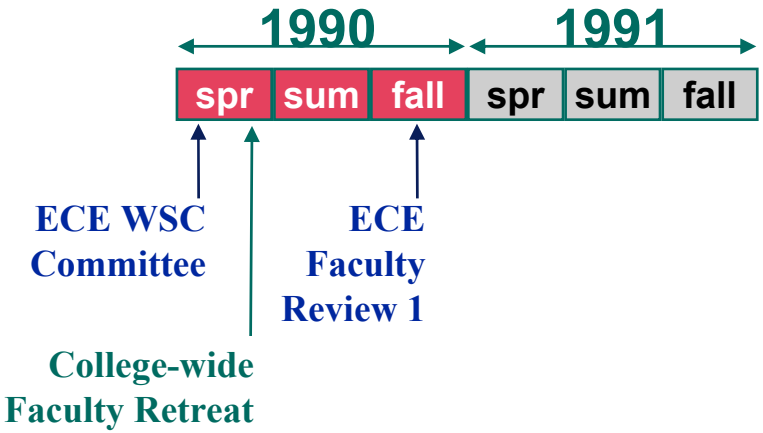
# Wipe-the-Slate-Clean: Timeline

- Roughly 2 years from concept to first students



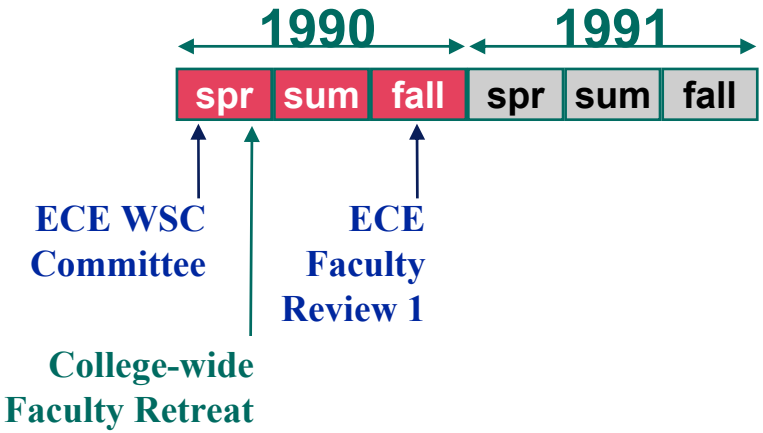

© R. Rutenbar, CMU 1997 

# Tactical Issues: Start-up




- **Frequent meetings**
  - Essentially weekly for almost a year
  - Started as brainstorming, moved to problem ID, then solutions
- **Frequent write-ups**
  - Various “strawman” documents summarizing early, concretely the proposed options, even when *very* incomplete
  - Generated heat & light

# Tactical Issues: Year 1




- **First year: focused on curriculum *shape, philosophy***
  - Big issues: core, requirements, flexibility
  - *Didn't* do bean counting here--forces you into incrementalism
- **End of first year**
  - Preview version of curriculum presented at faculty meeting
  - Architecture proposed, details to-be-decided

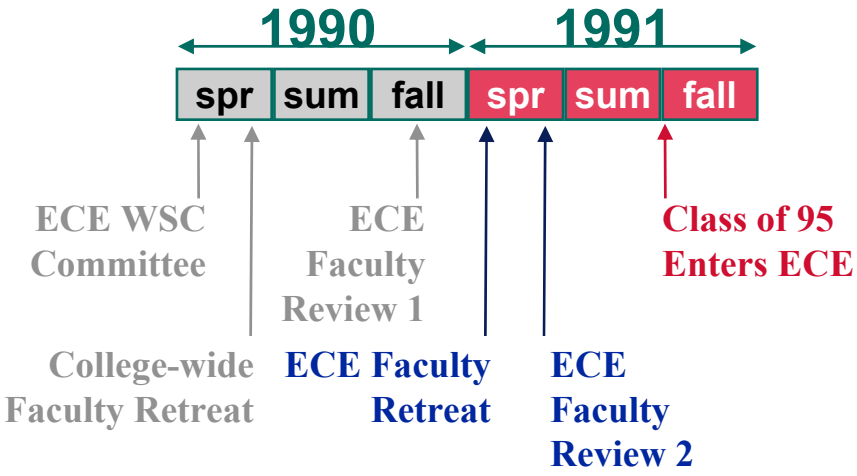
# From the First Report to Faculty

**"We hold these truths to be self-evident**

- Not everybody needs to know every ECE area
- Some students will be broad; others will be deep
- Not all ECE students become ECE-engineers for life
- Inter-disciplinary studies should supported, not prevented
- Demographics is important ==> Flexibility is *marketable"*

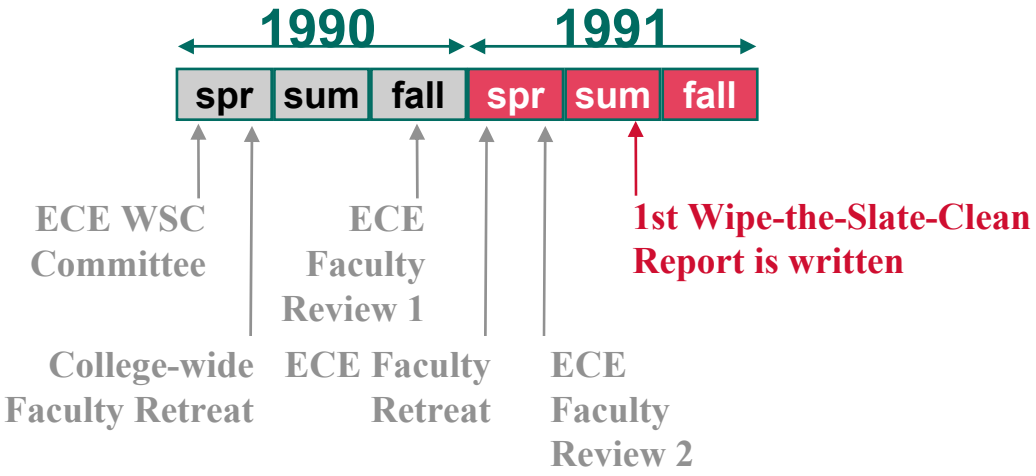
- **Motivated the *changes*, *shape* of proposed curriculum**

# Tactical Issues: Year 2




- **Second year: focus on buy-in, details**
  - Department-wide retreat held to hash out more details
  - Agreed on requirements (*statistics yes, chemistry no*), flexibility
  - *Still didn't* do full bean counting--committee fleshed out later
- **End of second year**
  - Detailed curriculum in place; first student enter pipeline

# Tactical Issues Year 2: Marketing




- **We didn't just design the curriculum, we *sold* it...**
  - Wrote a detailed exposition of motivation, process, results in '91
  - ~1000 copies requested around the world
  - Mentions in *Spectrum*, *Bus. Week*, ultimately *IEEE Proceedings*
  - Goal: convince greater community our approach was sound

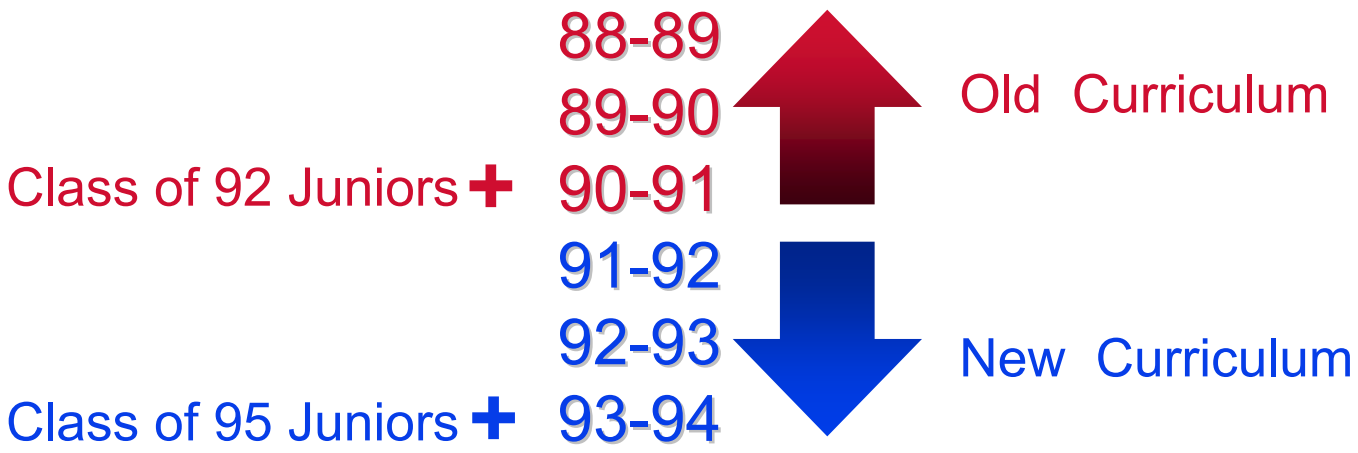
# Implementation: Accreditation

- **Problematic given our flexible architecture**
  - Didn't meet strict requirements for ABET EE or CompE
  - Didn't want to distort new curriculum into full compliance
- **Strategy**
  - Initially we added some extra constraints "at the margins"
  - Some of these were for CMU idiosyncrasies, some for ABET
  - Eventually, we chose to purse the "pure" form for accreditation
- **Outcome**
  - Success -- completely accredited by ABET in 1995

# Implementation: Measurement

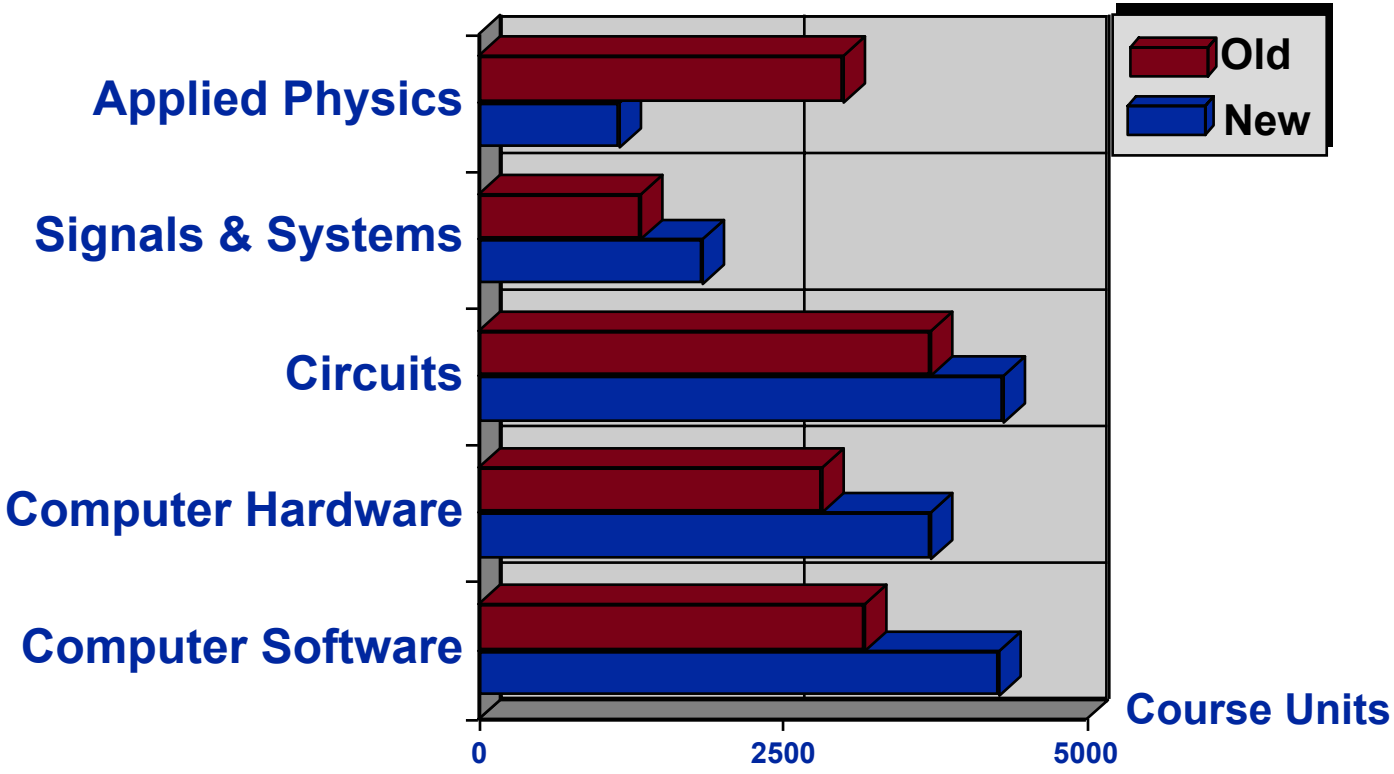
- **Radically different curriculum -- how do we tell it works?**
  - Anecdotal -- student attitudes, etc.
  - Quantitative -- measure course-taking behavior

- **Example: first controlled experiment**



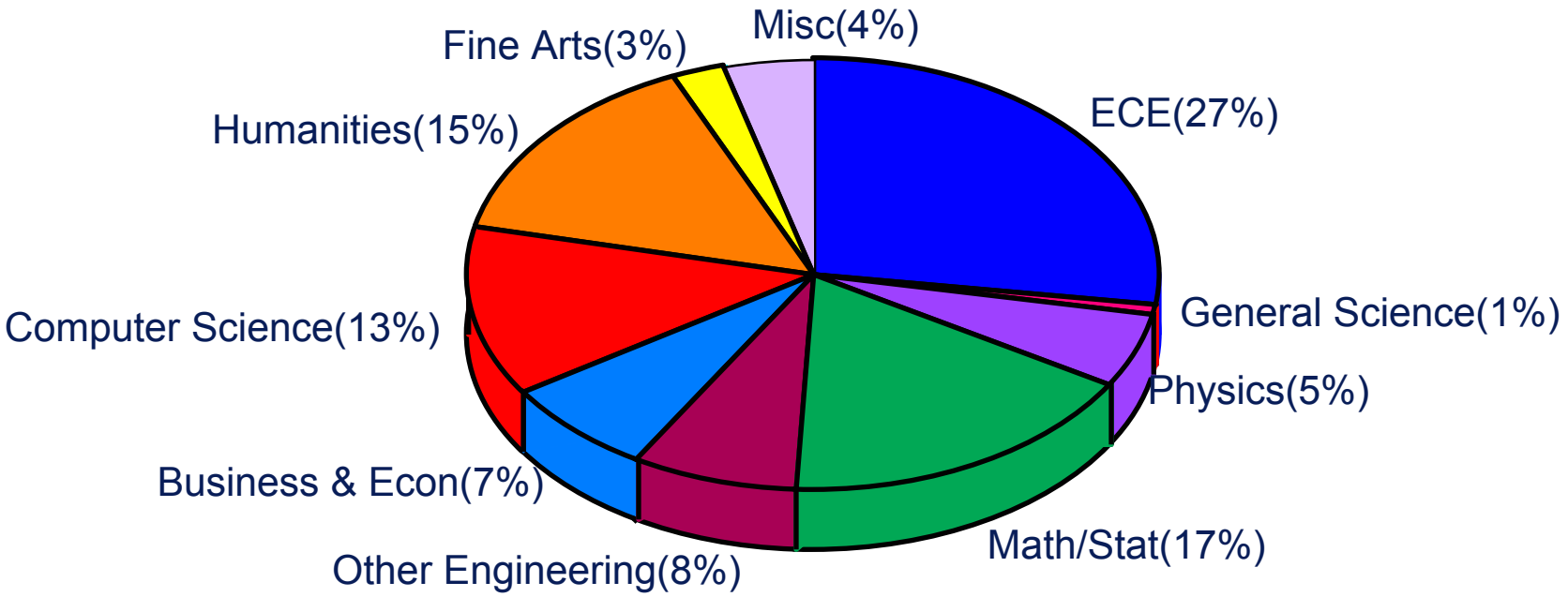
# Old versus New Curriculum

- **Example result: What do they elect in ECE?**
  - More computers, less applied physics
  - Impact: changed some math courses, some Ap Physics courses



# Current Tracking

- **Track course-taking behavior in each ECE cohort**
  - Let's us see breadth, depth, in ECE and at CMU level
  - Example: "average" student course profile for ECE class of 1997



# Summary

- **Wipe-the-Slate-Clean as an *approach***
  - Significant merit as a strategy
  - Abandon your preconceived notions;  maximize flexibility
  - Allows you to avoid significant “legacy” problems

- **Wipe-the-Slate-Clean tactics**
  - Set up a vigorous, widely diverse faculty committee
  - Design “philosophy” & “shape” of curriculum first;  details later
  - Write down what you did & why--others want to know
  - Measure patterns of course taking behavior;  tune reqs, offerings