Summary of Ideas for the BSEE Degree in the 2002-2004 Catalog

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On Behalf of the BSEE Curriculum Committee

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April 14, 2000

Outline

- Introduction

- Curriculum Design

- 1998-2000 BSEE Degree

- Possible 2002-2004 BSEE Degree

- Conclusion

Motivations to Pursue BSEE

- Early 1980s: home computers, MTV, voiceband data modems, bulletin boards

- Late 1980s: PCs, analog cell phones, audio CD players, bulletin boards

- Early 1990s: laptops, digital cell phones, video CDs, Internet browsing

- Late 1990s: palm pilots, Internet cell phones, DVD players, MP3 players, ADSL and cable modems, Internet multimedia

Trends in Consumer Electronics

- Increasing amount of communications, signal processing, networking capabilities

- Increasingly digital: software has larger role

- Analog, RF, and optical subsystems needed to interface systems to physical world

- Devices and semiconductor manufacturing
  - Shrinking area, volume & power consumption
  - Exponential increase in processor speeds

Dressed for Success Today

- Mastery of "hard" skills
  - Fundamentals of mathematics, physics, chemistry
  - Theory and practice of electromagnetics, devices, circuits, software, and systems

- Mastery of "soft" skills
  - Oral and written engineering communication
  - Business practice of marketing, budgeting, product development, and ethics

Dressed for Success Tomorrow

- Mastery of "hard" skills
  - Fundamentals of mathematics, physics, *biology*
  - Theory and practice of electromagnetics, devices, circuits, systems, software, *networking*
  - *Design principles, abstraction, and complexity*
- Mastery of "soft" skills
  - Oral and written engineering communication
  - Business practice of marketing, budgeting, product development, and ethics

Curriculum Design

Maximize combination of hard + soft skills

Subject to constraints

- Four-year program for entering freshmen
- Two-year program for mature transfer students
- ABET guidelines
- IEEE guidelines
- University requirements

Transfer Students in 1999-2000

- Transferring from outside of UT Austin
  - 18.9% of new ECE students
  - 11 fresh., 39 soph., 24 juniors, 12 seniors
- Two concerns for ECE transfer students: smooth transition & expedience finishing
- EE411 tests: quiz 1 tests calculus/science

Student Status	Students	Quiz 1 Average	Quiz 1 Std. Dev.	Quiz 2 Average	Quiz 2 Std. Dev.
Non-transfer	85	62%	14%	80%	22%
Transfer	41	55%	13%	73%	22%

Summary of ABET Guidelines

- Educational objectives assessment

- Hard skills

  – 1 year college mathematics and basic science

  – 1.5 years of general engineering topics: electrical engineering sciences and design

- Soft skills: design subject to constraints

  – Economic, environmental, health, and safety

  – Sustainability and manufacturability

  – Social, political, and ethical

Summary of IEEE Guidelines

- Probability and statistics

- Differential and integral calculus

- Basic and engineering sciences

- Software

- Systems of hardware/software components

- Advanced mathematics

  - Differential equations and linear algebra

  - *Complex variables* and *discrete mathematics*

University Requirements

- English and writing
  - English 306 Rhetoric and Composition
  - English 316K Masterworks of Literature
  - Two additional upper division courses
- Social science
  - Six semester hours of American government
  - Six semester hours of American history
  - Three more semester hours of social science

University Requirements

- Natural science and mathematics
  - Three semester hours of mathematics
  - Six semester hours in an area of natural science
  - Three semester hours in natural science, mathematics, or computer science
- Fine arts and humanities
  - Three semester hours of fine arts or humanities
- *Foreign language requirement*

1998-2000 BSEE Degree
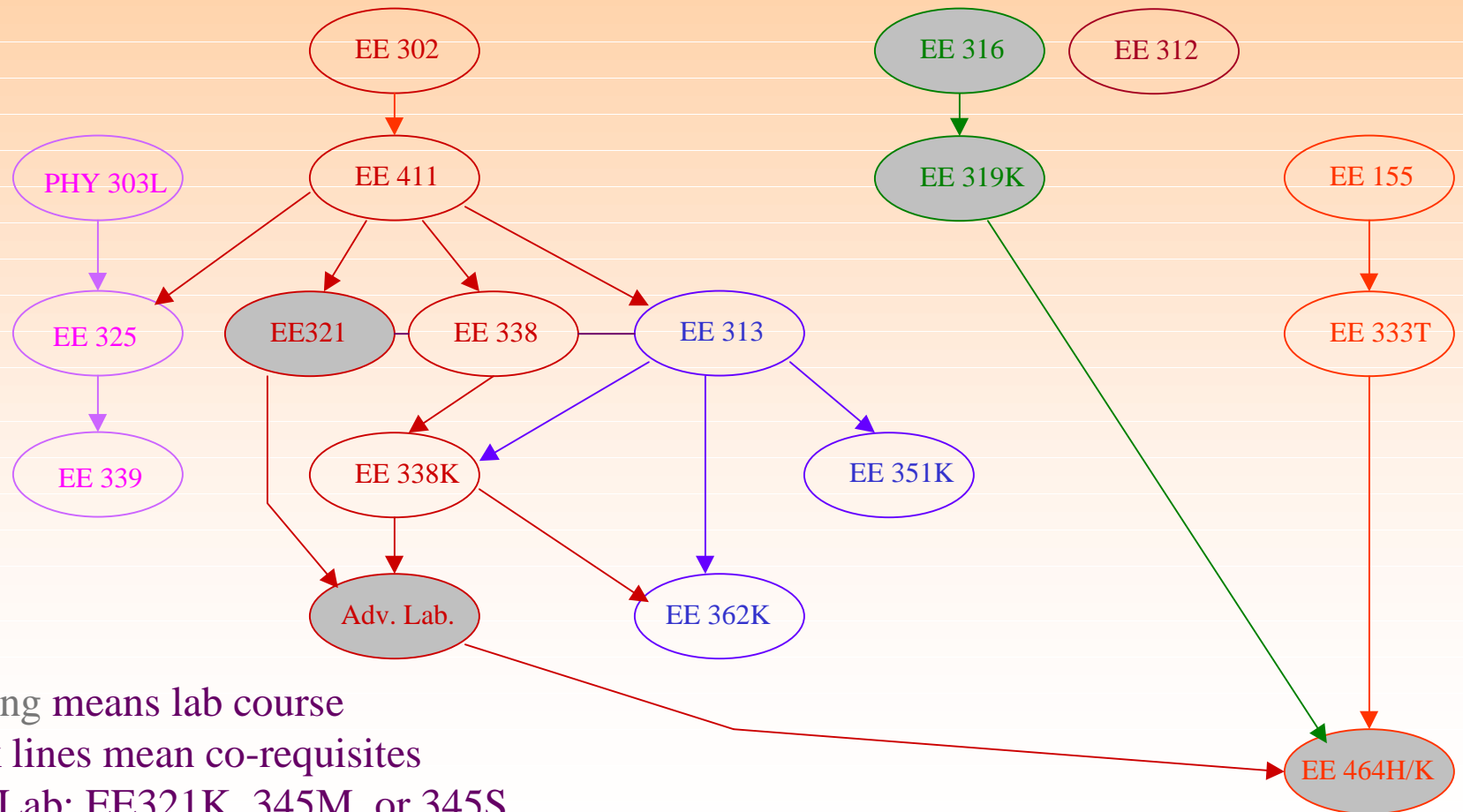
Electromag. and Devices (3 courses)

Circuits (6 courses)

Systems (3 courses)

Digital Hardware (2 courses)

Software (1 course)

Technical Writing (3 courses)

EE 302

EE 316

EE 312

PHY 303L

EE 411

EE 319K

EE 155

EE 325

EE321

EE 338

EE 313

EE 339

EE 338K

EE 351K

EE 333T

Adv. Lab.

EE 362K

EE 464H/K

- Shading means lab course
- Black lines mean co-requisites
- Adv. Lab: EE321K, 345M, or 345S

1998-2000 BSEE Curriculum

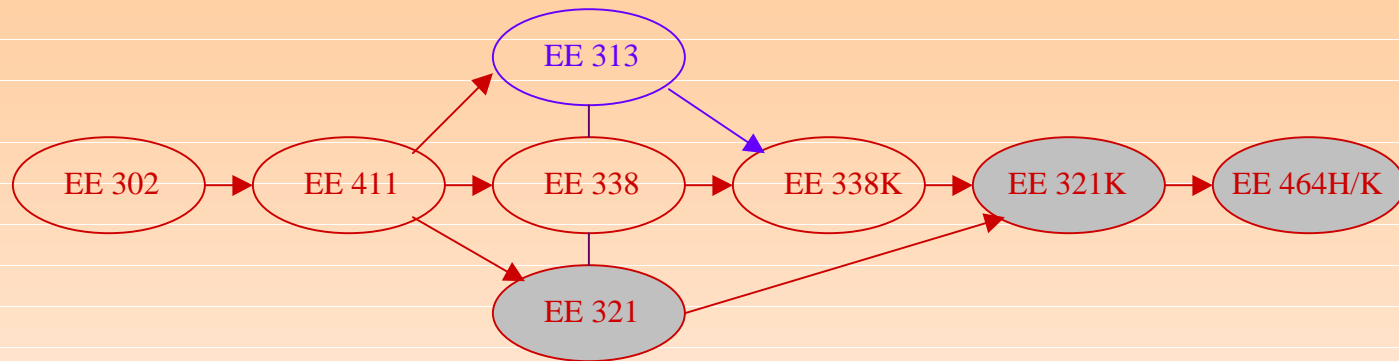| Topic	Percentage	Credit Hours	Courses
analog circuits/systems	40%	24.3	3/5 EE302 + 2/3 EE313 + EE411 + 1/2 EE321 + EE321K + EE338 + EE338K + EE351K + EE362K
specialization	18%	11.0	1/2 EE464H/K + 3 tech. area electives
analog devices/ electromagnetics	10%	6.0	EE325 + EE339
technical communication	9%	5.6	EE155 + EE333T + 4/10 EE464H/K
digital logic/microprocessors	8%	5.0	1/6 EE302 + EE316 + 1/2 EE319K
programming	8%	4.5	EE312 + 1/2 EE319K
discrete-time processing/ data acquisition	4%	2.5	1/3 EE313 + 1/2 EE321
business practice	2%	1.1	0.2333 EE302 (ethics) + 1/10 EE464H/K (ethics)
Total	100%	60.0	

Required EE courses: 51 hours

Technical area electives: 9 hours

Hard skills: 53.3 hours

Soft skills: 6.7 hours

Longest Pre-requisite Chain

EE 302 → EE 411 → EE 338 → EE 338K → EE 321K → EE 464H/K

EE 411 → EE 313 → EE 338K

EE 338 → EE 321 → EE 321K

- May delay EE electives to senior year
- May delay E464J/K Senior Design Project to last semester
- May prevent mature transfer students from finishing BSEE degree in less than 3 years

BSEE Technical Area Choices

Technical Area	Students	Percentage
Computer Engineering	230	37%
Telecommunications and Signal Proc.	99	16%
Management and Production	66	11%
Integrated Electronics	62	10%
Electronic Materials and Devices	28	5%
Electromagnetic Engineering	25	4%
Premed/Biomedical	25	4%
Software Engineering	23	4%
Communication and Control	21	3%
Biomedical Engineering	21	3%
Information Systems Engineering	12	2%
Power Systems and Energy	9	1%

Based on Fall 1999 data for 621 students who declared.
Not included: 306 Comp. Eng. and 785 Undecided majors.

Possible 2002-2004 BSEE Degree

- Bottom-up treatment

- Increase balance of hard skills

- Give more choices to the student
  - Add choice of a second technical area
  - Give 5 choices instead of 3 for advanced lab
  - Add circuit design technical area

- Increase soft skills
  - Require EE366 Engineering Economics I

Digital Hardware

- EE306 Introduction to Computing
  - Bottom-up treatment of computer architecture from gates to assembly language programming
  - Overlap with EE302, EE316, and EE319K which frees these courses to teach other topics
- EE319K Microprocessor Appl. & Org.
  - Move 50-75% of EE345L to EE319K
  - Move 50-75% of EE345M into EE345L
  - Merge EE345M/360P into real-time OS course

Software

- EE312/EE322 Programming I & II
  - Bottom-up: procedural then object-oriented
  - Data types, functions, recursion, algorithms
  - Algorithm analysis
- EE360C Data Structures in C++
  - Elective in both EE and CE curricula
  - Graph theory algorithms and complexity
  - Algorithm design

Circuits and Systems Courses

Course	Remove	Add
EE302	Dynamic circuit analysis	Signal/system representation
	Digital system design	Finite state machines
EE411	Two-port networks	Operational amplifiers
		Bode plots
		Three-phase circuits
		Laplace transforms
EE313	Signal/system representation	Review sig/sys representation
	Quantization	AM/FM modulation
EE338		Two-port networks
		Lab component (EE438)

Add one-hour lab component to EE338 to form EE438

No proposed changes to EE351K or EE362K

Lab for EE438 Electronic Circuits I

- Generation and acquisition of test signals
  sinusoids and noise

- Current, voltage, impedance measurements
  2/3-terminal devices, analyze mystery circuit

- Complex transfer function measurement
  transfer function, magnitude/phase response to sinusoidal and noise input, Bode plots/breakpoints

- Spectrum measurements and analysis

Advanced Laboratory Course

- Prepare a student for Senior Design Project while leveraging student's technical area:
  - EE321 Electrical Engineering Lab I
  - EE440 Microelectronics Fabrication Tech.
  - EE345L Microprocessor Interfacing Lab
  - EE345S Real-Time Digital Sig. Proc. Lab *OR*
  - EE374L Applications of Biomedical Eng.
- May be counted as technical area elective

New Circuit Design Tech. Area

- EE316 Digital Systems Engineering
  - Digital logic + FPGAs + VHDL/Verilog
  - Remove overlap with EE306 (CS310 adopted an EE306 approach for Spring 2000)
  - Add EE360M topics that are not in EE360R
- EE321 Electrical Engineering Lab I
- EE321K Electrical Engineering Lab II
- EE338K Electronic Circuits II

Possible BSEE Degree 2002-2004

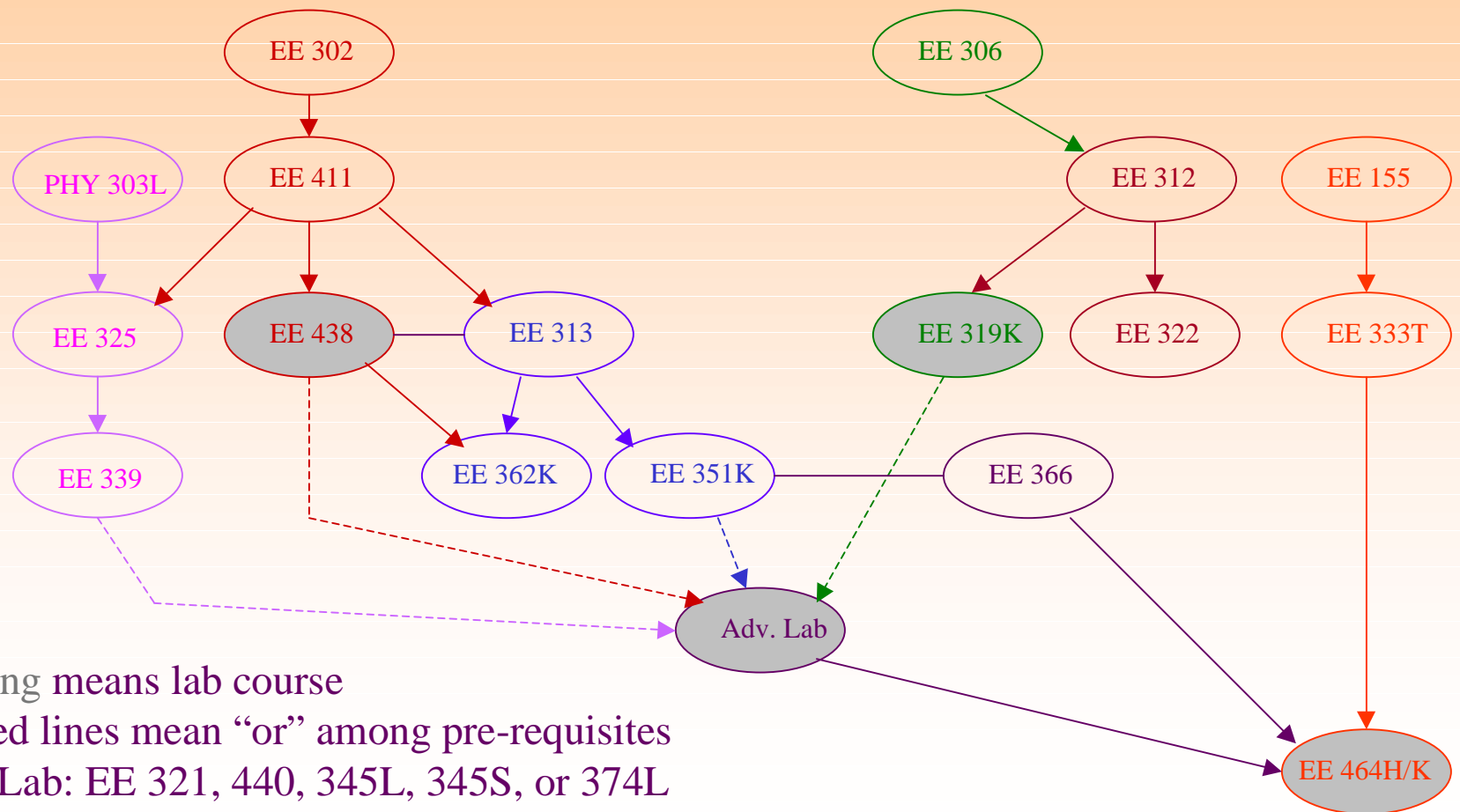Electromag. and Devices (3 courses)
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Digital Hardware (2 courses)
Software (2 courses)
Technical Writing (3 courses)

EE 302
EE 306
PHY 303L
EE 411
EE 312
EE 155
EE 325
EE 438
EE 313
EE 319K
EE 322
EE 333T
EE 339
EE 362K
EE 351K
EE 366
Adv. Lab
EE 464H/K

- Shading means lab course
- Dashed lines mean "or" among pre-requisites
- Adv. Lab: EE 321, 440, 345L, 345S, or 374L

Possible 2002-2004 Curriculum

Topic	Percentage	Credit Hours	Formula
specialization	30%	20.0	Advanced Lab + 1/2 EE464H/K + 5 technical area electives
analog circuits/systems	24%	16.5	1/2 EE302 + 2/3 EE313 + EE411 + 3/4 EE438 + EE351K + EE362K
digital logic/ microprocessors	10%	6.5	1/6 EE302 + EE306 + EE319K
programming	9%	6.0	EE312 + EE322
analog devices/ electromagnetics	9%	6.0	EE325 + EE339
technical communication	8%	5.6	EE155 + EE333T + 4/10 EE464H/K
business practice	6%	3.9	0.2333 EE302 (ethics) + 1/10 EE464H/K (ethics) + EE366 (economics)
discrete-time processing/ data acquisition	4%	2.5	1/6 EE302 + 1/3 EE313 + 1/4 EE438
Total	100%	67.0	

Required EE courses: 49 hours

Technical area electives: 18 hours

Hard skills: 47.5 hours

Soft skills: 9.5 hours

Other Required Courses

- Two technical areas: 3 courses for each area

- Sciences: CH301, PHY303K/103M (Lab)
  PHY303L is shown in electromagnetics track

- Math: M408C, M408D, M427K, M340L

- Humanities: E306, E316, GOV310L, GOV312L, HIS315K, HIS315L

- Four other electives: Fine Arts/Humanities, Social Science, Technical, Free

BSEE Degree First Year

Fall Semester	Hours	Spring Semester	Hours
CH 301 Principles of Chemistry	3	EE 302 Intro. to Electrical and Computer Eng.	3
E 306 Rhetoric and Composition	3	EE312 Programming I	3
EE 306 Introduction to Computing	3	M 408D Sequences, Series, and Multivariable Calculus	4
M 408C Differential and Integral Calculus	4	PHY303K Engineering Physics I	3
Approved Fine Arts/Humanities Elective	3	PHY 103M Laboratory for Physics 303K	1
		Approved Social Science Elective	3
Total	16	Total	17

New/redesigned courses are shown in yellow

BSEE Degree Second Year

Fall Semester	Hours	Spring Semester	Hours
EE 411 Circuit Theory	4	E 316K Masterworks of Literature	3
EE 322 Programming II	3	EE 313 Linear Systems and Signals	3
EE 155 Electrical & Computer Eng. Seminar	1	EE 319K Microprocessor Programming	3
M 427K Advanced Calculus for Applications I	4	EE 325 Electromagnetic Engineering I	3
M 340L Matrices and Matrix Calculations	3	Approved Elective	3
PHY303L Engineering Physics II	3	Approved Technical Elective	3
Total	18	Total	18

New/redesigned courses are shown in yellow

BSEE Degree Third Year

Fall Semester	Hours	Spring Semester	Hours
EE 438 Electronic Circuits I	4	Advanced EE Laboratory Elective: EE321, EE440, EE345L, EE345S (formerly EE379K-17), or EE374L **	3/4
EE 339 Solid-State Electronic Devices	3	EE 333T Engineering Communication	3
EE 351K Probability, Statistics, and Random Processes	3	EE 362K Introduction to Automatic Control	3
Approved Technical Area	3	EE 366 Engineering Economics I *	3
Approved Technical Area	3	Approved Technical Area	3
Total	16	Total	15/16

New/redesigned courses are shown in yellow

BSEE Degree Fourth Year

Fall Semester	Hours	Spring Semester	Hours
EE 464H Electrical Engineering Honors Projects OR EE 464K Electrical Engineering Projects **	4	GOV 312L American Government	3
GOV 310L American Government	3	HIS 315L American History	3
HIS 315K American History	3	Approved Elective	3
Approved Technical Area	3	Approved Technical Area	3
Approved Technical Elective	3		
Total	16	Total	12

New/redesigned courses are shown in yellow

BSEE Technical Areas

- Computer and Software Engineering Areas
  - Replace them with the four technical areas for BSCE degree: VLSI, Computer Design, Software Development, and System Software

- Add Embedded Systems Area
  - EE345L Microprocessor Applications
  - EE345M Real-Time Operating Systems
  - EE345S Real-Time Digital Signal Proc. Lab

Conclusion: BSEE Degree

Topic	1998-2000 Credit Hours	2002-2004 Credit Hours
specialization	11.0	20.0
analog circuits/systems	24.3	16.5
digital logic/ microprocessors	5.6	6.5
programming	4.5	6.0
analog devices/ electromagnetics	6.0	6.0
technical communication	5.6	5.6
business practice	1.1	3.9
discrete-time processing/ data acquisition	2.5	2.5
Total	60.0	67.0

Changes are shown in yellow

Comparison of BSEE Degrees

- EE366 replaces engineering science elective
- Newly created required courses
    - EE306 Introduction to Computing
    - EE322 Programming II
- Six courses made elective
    - PHY103N, 355
    - EE316, 321, 321K, 338K (Circuit Design Area)
- Old BSEE degree is new BSEE degree with Circuit Design chosen as one technical area