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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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

### Table: Quiz Average Scores

<table>
<thead>
<tr>
<th>Student Status</th>
<th>Students</th>
<th>Quiz 1 Average</th>
<th>Quiz 1 Std. Dev.</th>
<th>Quiz 2 Average</th>
<th>Quiz 2 Std. Dev.</th>
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</thead>
<tbody>
<tr>
<td>Non-transfer</td>
<td>85</td>
<td>62%</td>
<td>14%</td>
<td>80%</td>
<td>22%</td>
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<tr>
<td>Transfer</td>
<td>41</td>
<td>55%</td>
<td>13%</td>
<td>73%</td>
<td>22%</td>
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</tbody>
</table>
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)

- **PHYS 303L**
- **EE 302**
- **EE 411**
- **EE 325**
- **EE 339**
- **EE 338**
- **EE 362K**
- **EE 351K**
- **EE 316**
- **EE 319K**
- **EE 312**
- **EE 155**
- **EE 333T**
- **EE 464H/K**

- **EE 345M or 345S**
- **EE 321**
- **EE 338K**
- **Adv. Lab.**
- **EE 313**

- **Shading** means lab course
- **Black lines** mean co-requisites
- **Adv. Lab:** EE321K, 345M, or 345S
# 1998-2000 BSEE Curriculum

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

**Required EE courses:** 51 hours  
**Technical area electives:** 9 hours  
**Hard skills:** 53.3 hours  
**Soft skills:** 6.7 hours
Longest Pre-requisite Chain

- 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

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

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

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

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)  Circuits (3 courses)  Systems (3 courses)

EE 302  EE 411  EE 313

PHY 303L  EE 325  EE 438

EE 339

EE 306  EE 312  EE 319K  EE 322  EE 333T

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Percentage</th>
<th>Credit Hours</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>specialization</td>
<td>30%</td>
<td>20.0</td>
<td>Advanced Lab + 1/2 EE464H/K + 5 technical area electives</td>
</tr>
<tr>
<td>analog circuits/systems</td>
<td>24%</td>
<td>16.5</td>
<td>1/2 EE302 + 2/3 EE313 + EE411 + 3/4 EE438 + EE351K + EE362K</td>
</tr>
<tr>
<td>digital logic/microprocessors</td>
<td>10%</td>
<td>6.5</td>
<td>1/6 EE302 + EE306 + EE319K</td>
</tr>
<tr>
<td>programming</td>
<td>9%</td>
<td>6.0</td>
<td>EE312 + EE322</td>
</tr>
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<td>analog devices/electromagnetics</td>
<td>9%</td>
<td>6.0</td>
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<td>business practice</td>
<td>6%</td>
<td>3.9</td>
<td>0.2333 EE302 (ethics) + 1/10 EE464H/K (economics)</td>
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<tr>
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<td>4%</td>
<td>2.5</td>
<td>1/6 EE302 + 1/3 EE313 + 1/4 EE438</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>67.0</td>
<td></td>
</tr>
</tbody>
</table>

- **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

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Hours</th>
<th>Spring Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 301 Principles of Chemistry</td>
<td>3</td>
<td>EE 302 Intro. to Electrical and Computer Eng.</td>
<td>3</td>
</tr>
<tr>
<td>E 306 Rhetoric and Composition</td>
<td>3</td>
<td>EE 312 Programming I</td>
<td>3</td>
</tr>
<tr>
<td>EE 306 Introduction to Computing</td>
<td>3</td>
<td>M 408D Sequences, Series, and Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>M 408C Differential and Integral Calculus</td>
<td>4</td>
<td>PHY 303K Engineering Physics I</td>
<td>3</td>
</tr>
<tr>
<td>Approved Fine Arts/Humanities Elective</td>
<td>3</td>
<td>PHY 103M Laboratory for Physics 303K</td>
<td>1</td>
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<tr>
<td>Total</td>
<td>16</td>
<td>Approved Social Science Elective</td>
<td>3</td>
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<tr>
<td>Total</td>
<td>16</td>
<td>Total</td>
<td>17</td>
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</table>

New/redesigned courses are shown in **yellow**
# BSEE Degree Second Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Hours</th>
<th>Spring Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 411 Circuit Theory</td>
<td>4</td>
<td>E 316K Masterworks of Literature</td>
<td>3</td>
</tr>
<tr>
<td>EE 322 Programming II</td>
<td>3</td>
<td>EE 313 Linear Systems and Signals</td>
<td>3</td>
</tr>
<tr>
<td>EE 155 Electrical &amp; Computer Eng. Seminar</td>
<td>1</td>
<td>EE 319K Microprocessor Programming</td>
<td>3</td>
</tr>
<tr>
<td>M 427K Advanced Calculus for Applications I</td>
<td>4</td>
<td>EE 325 Electromagnetic Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>M 340L Matrices and Matrix Calculations</td>
<td>3</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>PHY303L Engineering Physics II</td>
<td>3</td>
<td>Approved Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>Total</td>
<td>18</td>
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New/redesigned courses are shown in yellow
# BSEE Degree Third Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Hours</th>
<th>Spring Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 438 Electronic Circuits I</td>
<td>4</td>
<td>Advanced EE Laboratory Elective:</td>
<td>3/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EE321, EE440, EE345L, EE345S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(formerly EE379K-17), or EE374L **</td>
<td></td>
</tr>
<tr>
<td>EE 339 Solid-State Electronic Devices</td>
<td>3</td>
<td>EE 333T Engineering Communication</td>
<td>3</td>
</tr>
<tr>
<td>EE 351K Probability, Statistics, and Random Processes</td>
<td>3</td>
<td>EE 362K Introduction to Automatic Control</td>
<td>3</td>
</tr>
<tr>
<td>Approved Technical Area</td>
<td>3</td>
<td>EE 366 Engineering Economics I *</td>
<td>3</td>
</tr>
<tr>
<td>Approved Technical Area</td>
<td>3</td>
<td>Approved Technical Area</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>Total</td>
<td>15/16</td>
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New/redesigned courses are shown in yellow
# BSEE Degree Fourth Year

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<th>Fall Semester</th>
<th>Hours</th>
<th>Spring Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 464H Electrical Engineering Honors Projects OR EE 464K Electrical Engineering Projects **</td>
<td>4</td>
<td>GOV 312L American Government</td>
<td>3</td>
</tr>
<tr>
<td>GOV 310L American Government</td>
<td>3</td>
<td>HIS 315L American History</td>
<td>3</td>
</tr>
<tr>
<td>HIS 315K American History</td>
<td>3</td>
<td>Approved Elective</td>
<td>3</td>
</tr>
<tr>
<td>Approved Technical Area</td>
<td>3</td>
<td>Approved Technical Area</td>
<td>3</td>
</tr>
<tr>
<td>Approved Technical Elective</td>
<td>3</td>
<td>Total</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>Total</td>
<td>12</td>
</tr>
</tbody>
</table>

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

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

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