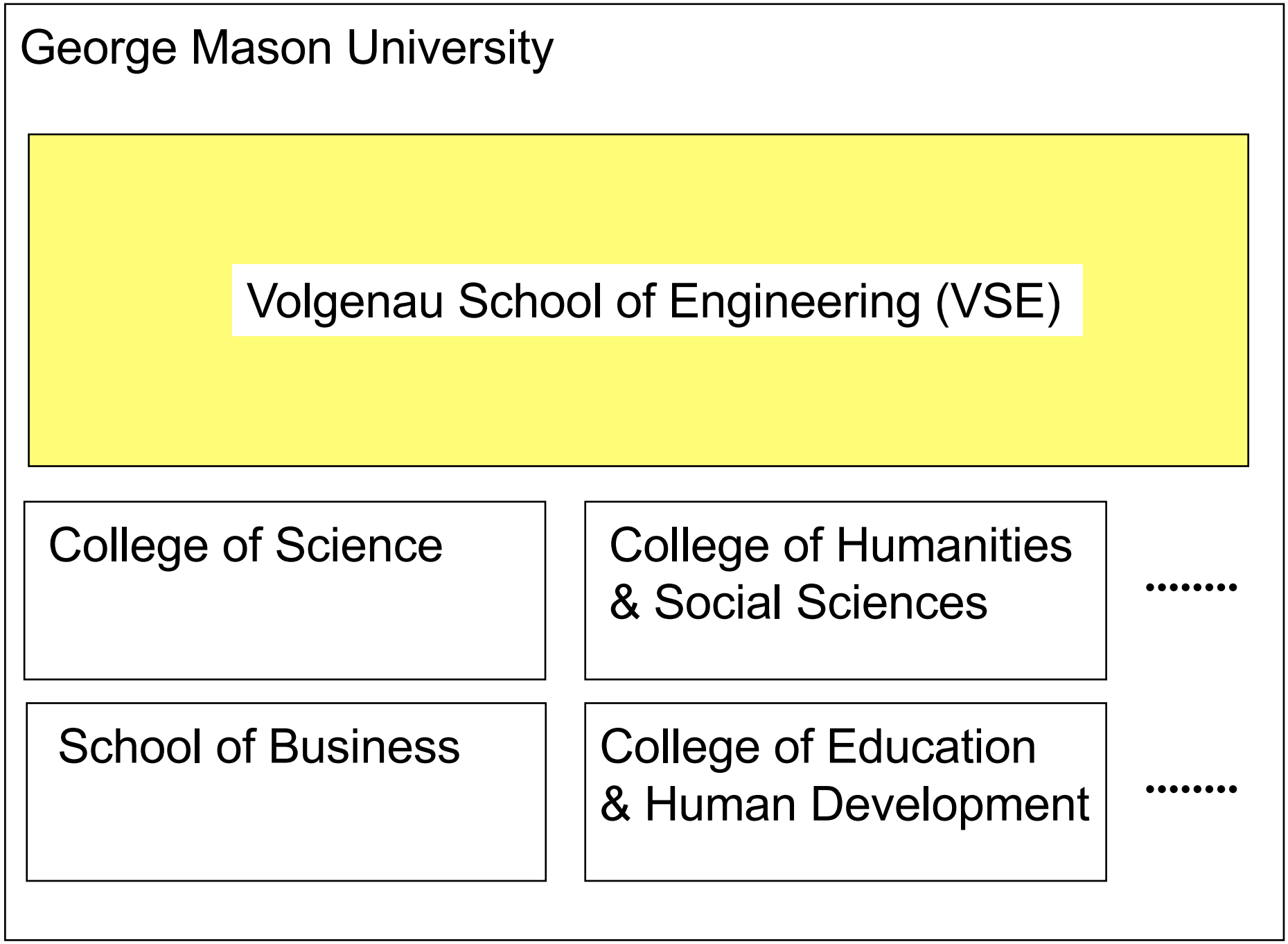
MS in Electrical Engineering
&
MS in Computer Engineering

Choosing a Specialization Area
& Degree Option

Useful Hints


George Mason University
Volgenau School of Engineering (VSE)
College of Science
College of Humanities & Social Sciences
.....
School of Business
College of Education & Human Development
.....

Volgenau School of Engineering

Eight Departments:

ECE	BENG	CS	IST	CEIE	STAT	SEOR	ME

ECE – Electrical and Computer Engineering
BENG – Bioengineering
CS – Computer Science
IST – Information Sciences and Technology
CEIE – Civil, Environmental, and Infrastructure Engineering
STAT – Statistics
SEOR – Systems Engineering and Operations Research
ME – Mechanical Engineering

Academic Programs run by the ECE Department

Undergraduate Degrees

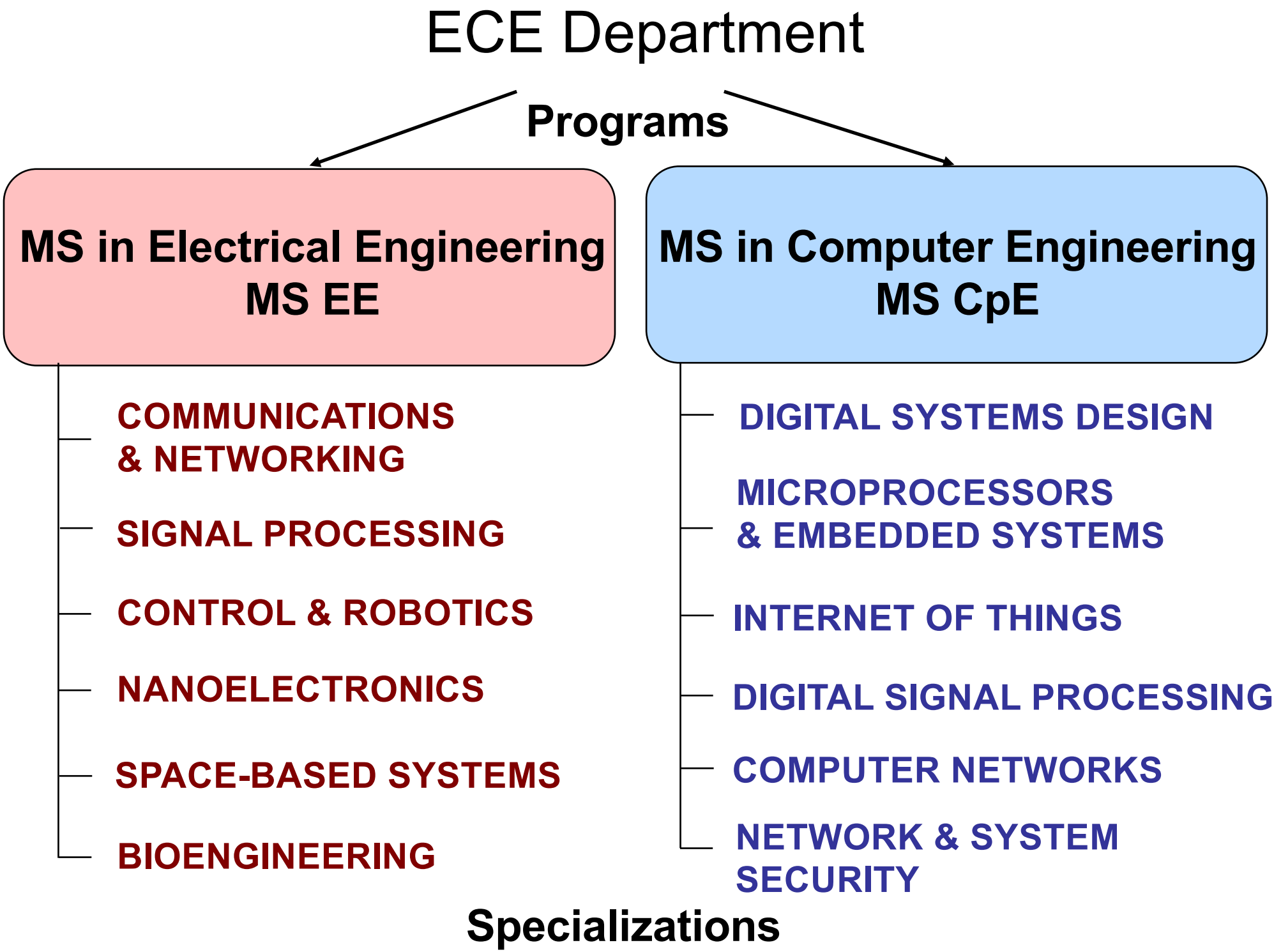
BS in Electrical Engineering
BS in Computer Engineering

Master Degrees

MS in Electrical Engineering
MS in Computer Engineering
MS in Telecommunications
MS in Digital Forensics and Cyber Analysis

PhD Degrees

PhD in Electrical and Computer Engineering


ECE Department
Programs
MS in Electrical Engineering
MS EE
MS in Computer Engineering
MS CpE
COMMUNICATIONS & NETWORKING
SIGNAL PROCESSING
CONTROL & ROBOTICS
NANOELECTRONICS
SPACE-BASED SYSTEMS
BIOENGINEERING
DIGITAL SYSTEMS DESIGN
MICROPROCESSORS & EMBEDDED SYSTEMS
INTERNET OF THINGS
DIGITAL SIGNAL PROCESSING
COMPUTER NETWORKS
NETWORK & SYSTEM SECURITY
Specializations

Three Degree Options

8 courses + 2 semesters of ECE 799 Master's Thesis

OR

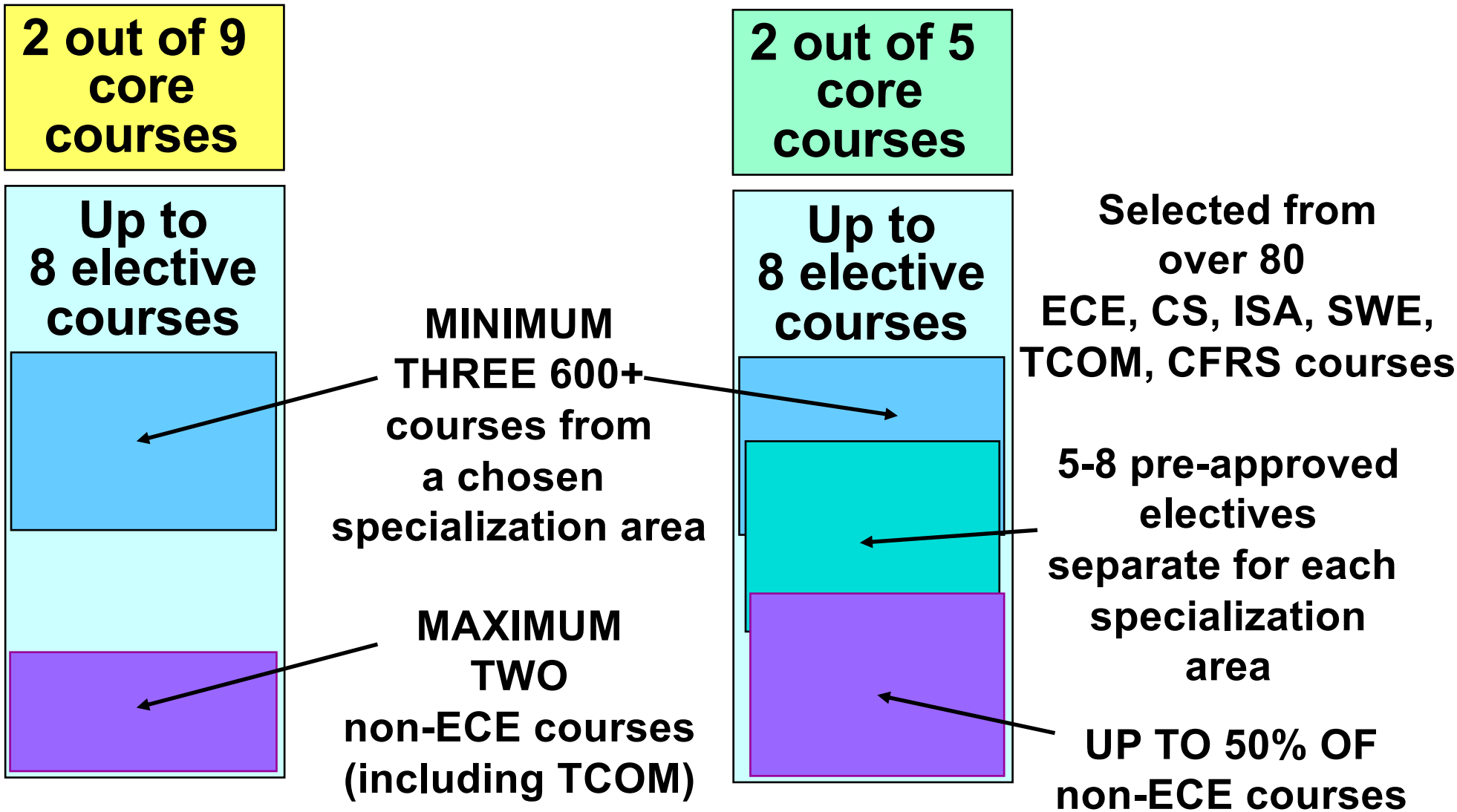
9 courses
+ 1 semester of ECE 798 Research Project
+ Scholarly Paper (typically equivalent to the ECE 798 report & presentation)

OR

10 courses + Scholarly Paper (an individual project in one of the advanced courses)

MS EE

MS CpE


2 out of 9 core courses
Up to 8 elective courses
MINIMUM THREE 600+ courses from a chosen specialization area
MAXIMUM TWO non-ECE courses (including TCOM)
2 out of 5 core courses
Up to 8 elective courses
Selected from over 80 ECE, CS, ISA, SWE, TCOM, CFRS courses
5-8 pre-approved electives separate for each specialization area
UP TO 50% OF non-ECE courses

Core Courses
EE Program

Two core courses, with a B or better in each, from the following:

- ECE 521: Linear Systems and Control
- ECE 528: Introduction to Random Processes in Electrical and Computer Engineering
- ECE 548: Sequential Machine Theory *or*
- ECE 511: Microprocessors

- ECE 584: Semiconductor Device Fundamentals *or*
- ECE 565: Introduction to Optical Electronics

- ECE 526: Neural Engineering *or*
- ECE 527: Learning From Data

Core Courses
CpE Program

Two core courses, with a B or better in each, from the following:

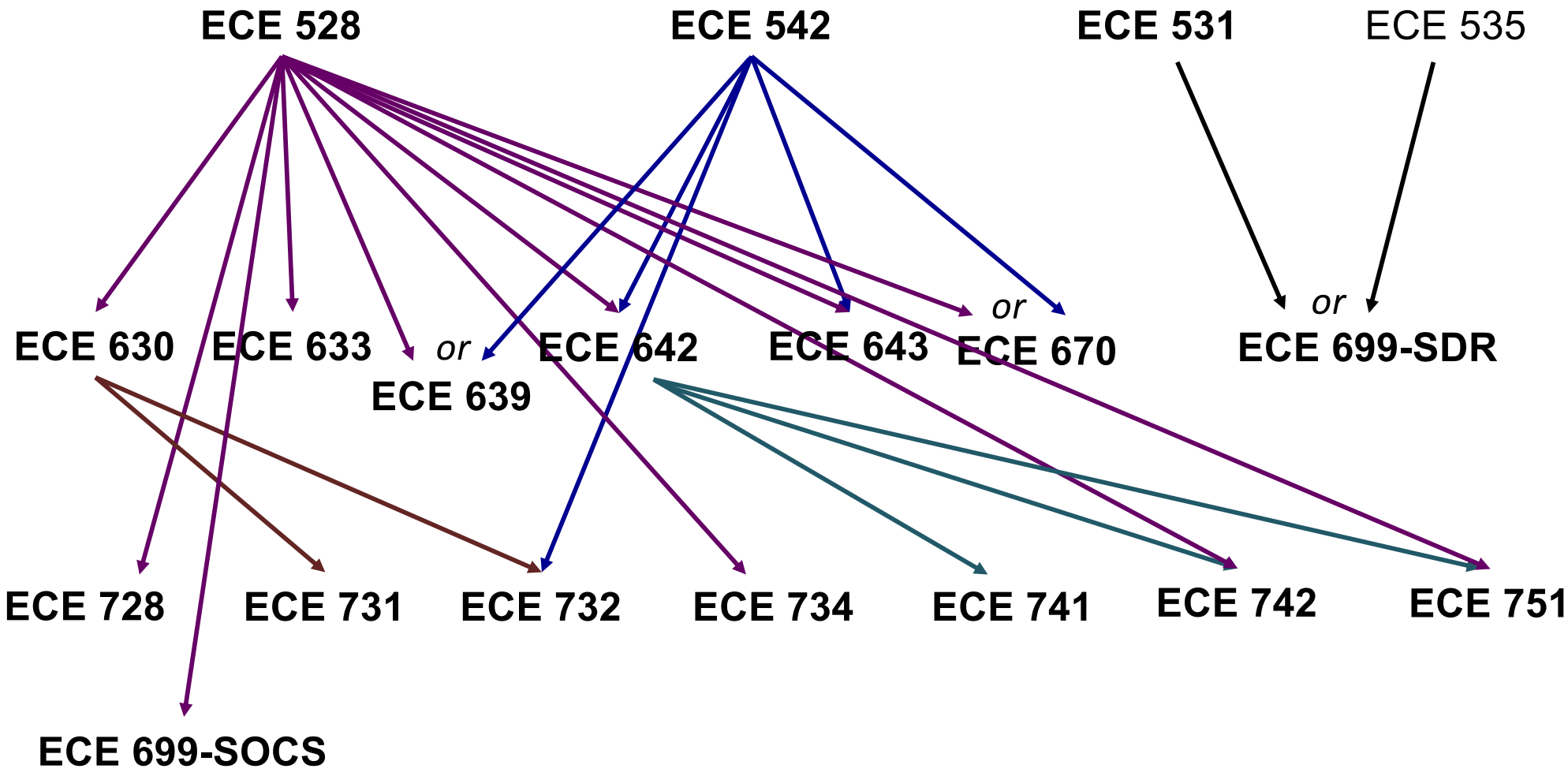
- CS 571: Operating Systems
- ECE 511: Microprocessors
- ECE 542: Computer Network Architectures and Protocols
- ECE 545: Digital System Design with VHDL
- ECE 548: Sequential Machine Theory

MS EE
Specialization Areas

Summary

- **Communications and Networking**
- **Signal Processing**
- **Controls and Robotics**
- **Nanoelectronics**
- **Space-Based Systems**
- **Bioengineering**

MS EE Courses
Communications and Networking
Group 1



MS EE Courses
Communications and Networking - Group 1

ECE 528 Random Processes in Electrical and Computer Engineering

ECE 531 Introduction to Wireless Communications and Networking

ECE 542 Computer Network Architectures and Protocols

ECE 630 Statistical Communication Theory

ECE 633 Coding Theory

ECE 639 Satellite Communications

ECE 642 Design and Analysis of Computer Communication Networks

ECE 643 Telecommunication Switching Systems

ECE 670 Principles of C^4I

ECE 728 Random Processes in Electrical and Computer Engineering II

ECE 731 Digital Communications

ECE 732 Mobile Communication Systems

ECE 734 Detection and Estimation Theory

ECE 741 Wireless Networks

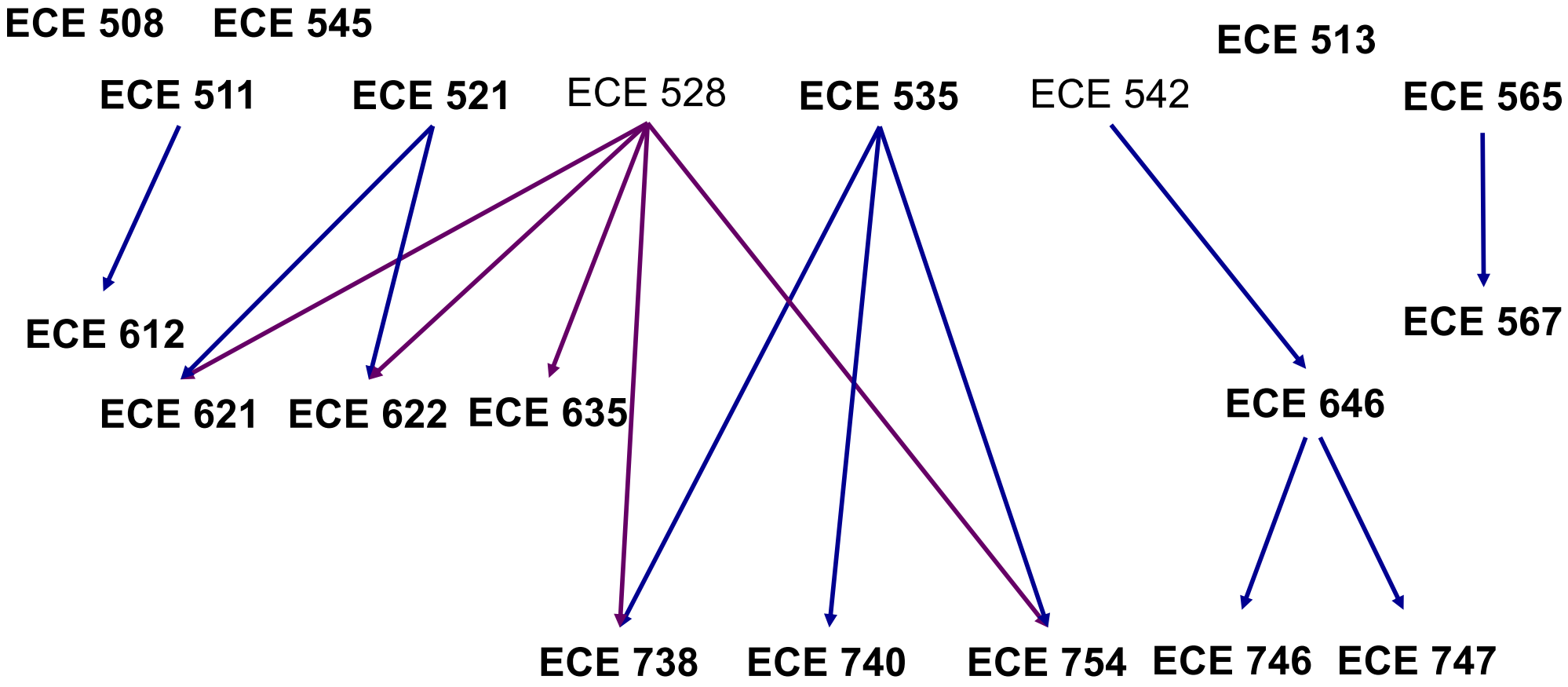
ECE 742 High Speed Networks

ECE 751 Information Theory

ECE 699-SDR Software-Defined Radio

ECE 699-SOCS Sparse Optimization and Compressive Sensing

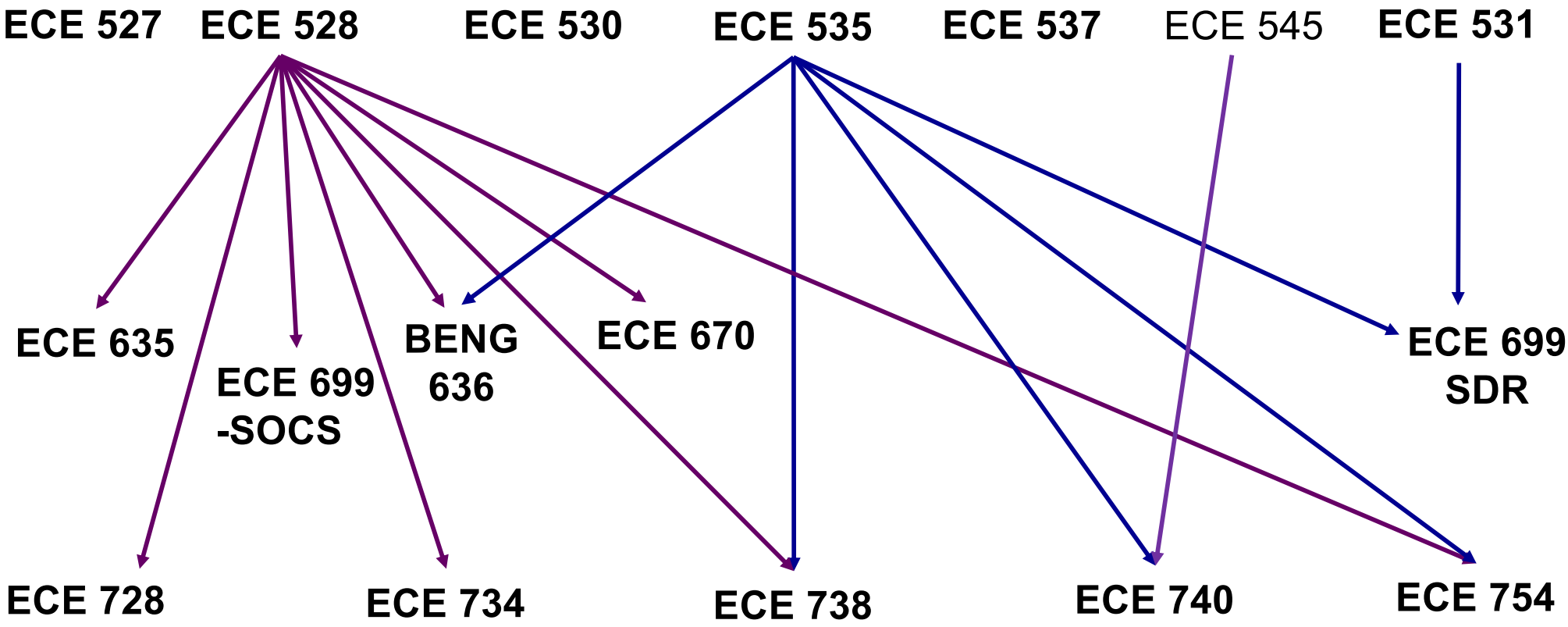
MS EE Courses
Communications and Networking
Group 2



MS EE Courses
Communications and Networking – Group 2

ECE 508 Internet of Things
ECE 513 Applied Electromagnetic Theory
ECE 535 Digital Signal Processing
ECE 545 Digital System Design with VHDL
ECE 567 Optical Fiber Communications
ECE 612 Real-Time Embedded Systems
ECE 621 Systems Identification
ECE 622 Kalman Filtering with Applications
ECE 635 Adaptive Signal Processing
ECE 646 Cryptography and Computer Network Security
ECE 738 Advanced Digital Signal Processing
ECE 740 Digital Signal Processing Hardware Architectures
ECE 746 Advanced Applied Cryptography
ECE 747 Cryptographic Engineering
ECE 754 Optimum Array Processing I

MS EE Courses
Signal Processing
Group 1



MS EE Courses
Signal Processing – Group 1

ECE 527 Learning From Data

ECE 528 Random Processes in Electrical and Computer Engineering

ECE 530 Sensor Engineering

ECE 531 Introduction to Wireless Communications and Networks

ECE 535 Digital Signal Processing

ECE 537 Introduction to Digital Image Processing

ECE 635 Adaptive Signal Processing

BENG 636 Advanced Biomedical Signal Processing

ECE 670 Principles of C^4I

ECE 734 Detection and Estimation Theory

ECE 728 Random Processes in Electrical and Computer Engineering

ECE 738 Advanced Digital Signal Processing

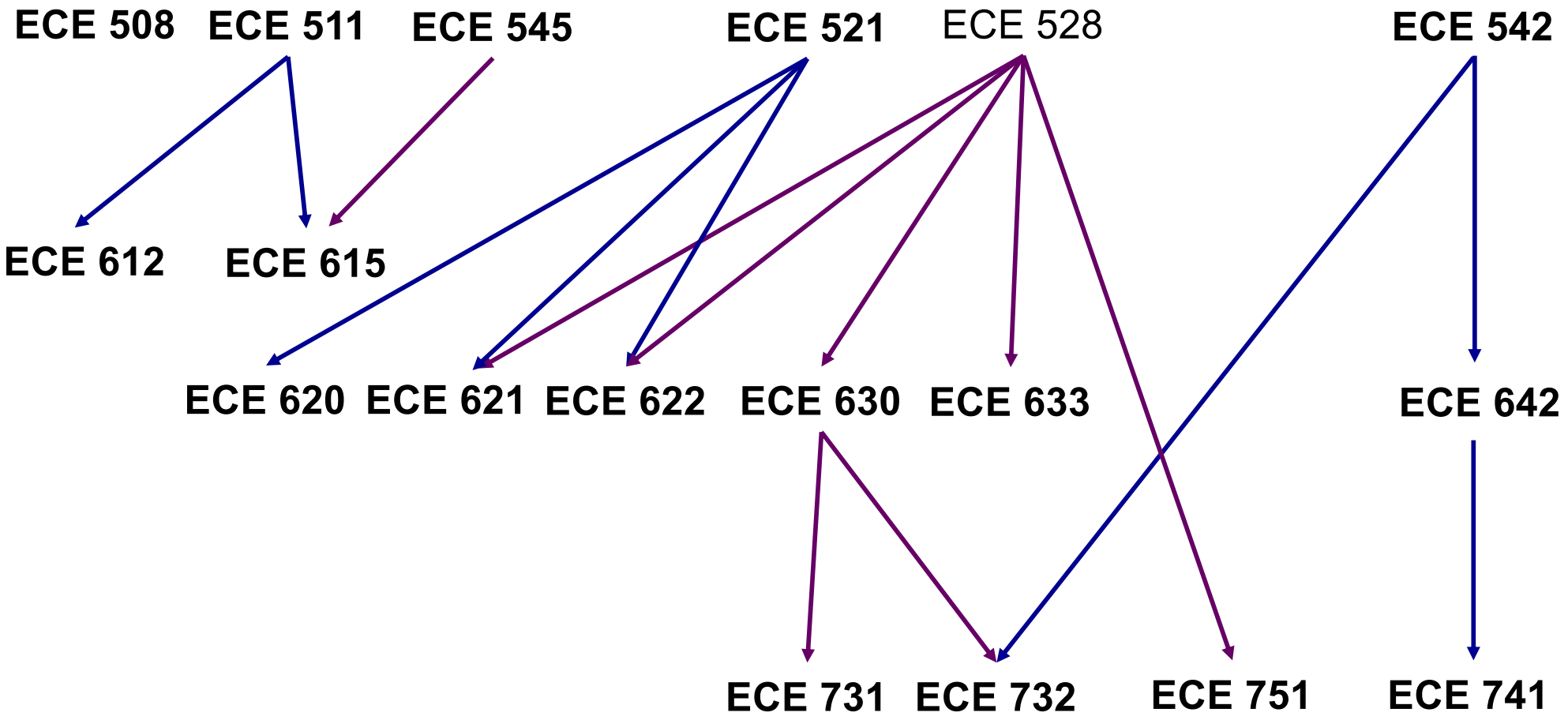
ECE 740 Digital Signal Processing Hardware Architectures

ECE 754 Optimum Array Processing I

ECE 699-SDR Software-Defined Radio

ECE 699-SOCS Sparse Optimization and Compressive Sensing

MS EE Courses
Signal Processing
Group 2



MS EE Courses
Signal Processing – Group 2

ECE 508 Internet of Things

ECE 521 Linear Systems and Control

ECE 542 Computer Network Architectures and Protocols

ECE 545 Digital System Design with VHDL

ECE 612 Real-Time Embedded Systems

ECE 615 Software/Hardware Codesign

ECE 620 Optimal Control Theory

ECE 621 Systems Identification

ECE 622 Kalman Filtering with Applications

ECE 630 Statistical Communication Theory

ECE 633 Coding Theory

ECE 642 Design and Analysis of Computer Communication Networks

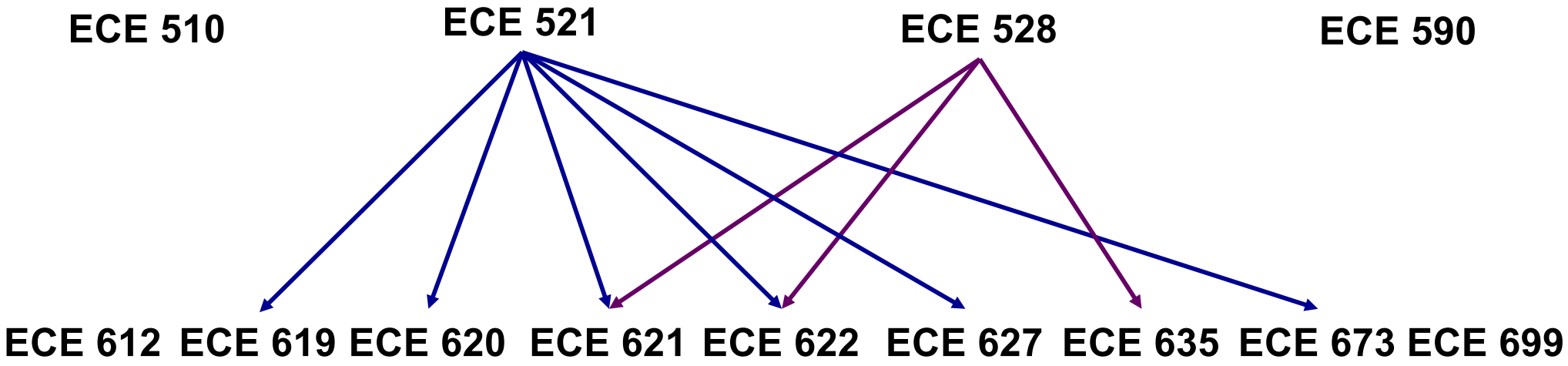
ECE 731 Digital Communications

ECE 732 Mobile Communication Systems

ECE 741 Wireless Networks

ECE 751 Information Theory

MSEE Courses
Control and Robotics



MSEE Courses
Control and Robotics

ECE 510 Real-Time Concepts

ECE 521 Linear Systems and Control

ECE 528 Introduction to Random Processes in ECE

ECE 590 Humanoid Robotics/Robot Design

ECE 612 Real-Time Embedded Systems

ECE 619 Nonlinear Systems and Control

ECE 620 Optimal Control Theory

ECE 621 Systems Identification

ECE 622 Kalman Filtering with Applications

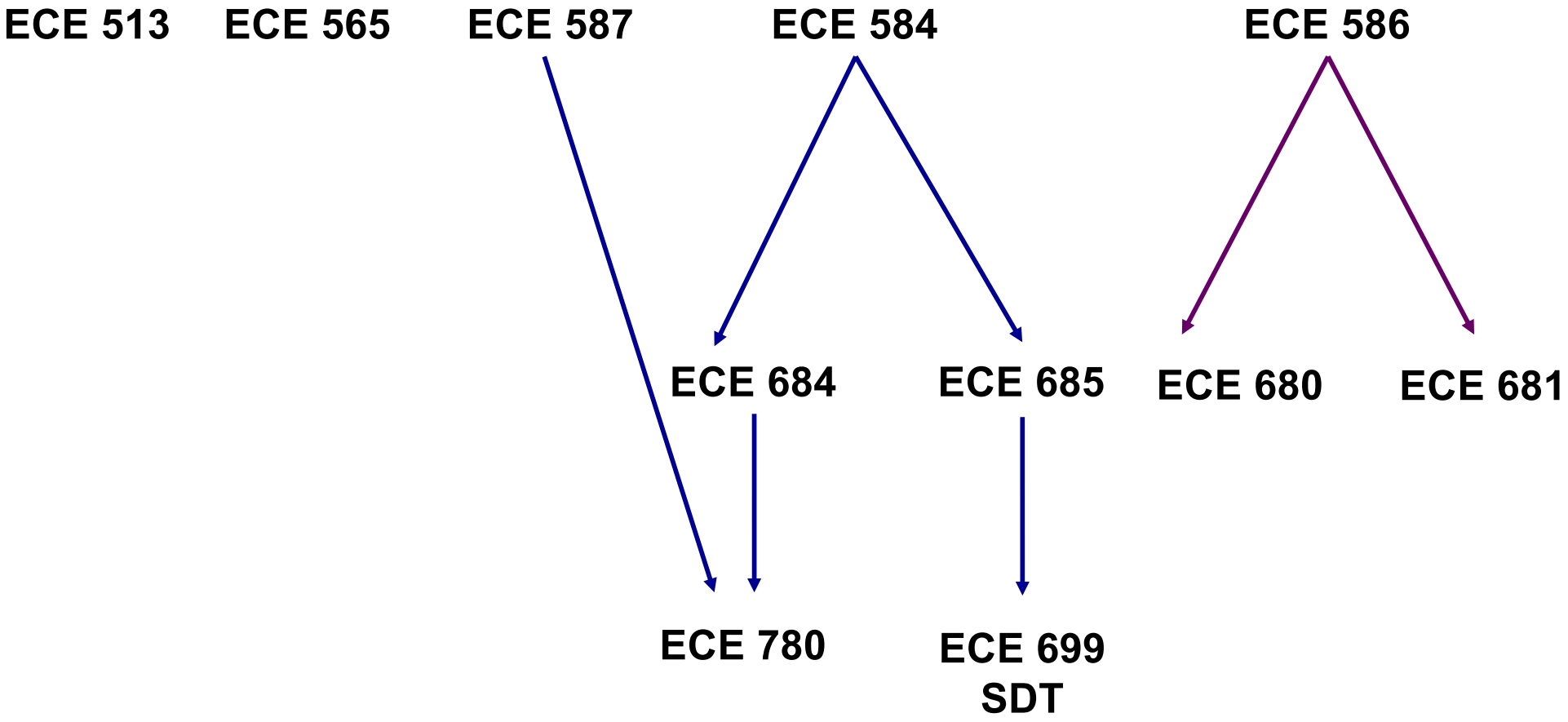
ECE 627 Adaptive Control

ECE 635 Adaptive Signal Processing

ECE 673/SYST 620 Discrete Event Systems

ECE 699 Cooperative Control of Multi-Agent Systems/Network Control

MSEE Courses
Nanoelectronics



MSEE Courses
Nanoelectronics

ECE 513 Applied Electromagnetic Theory

ECE 565 Introduction to Optical Electronics

ECE 584 Semiconductor Device Fundamentals

ECE 586 Digital Integrated Circuits

ECE 587 Design of Analog Integrated Circuits

ECE 680 Physical VLSI Design

ECE 681 VLSI Design for ASICs

ECE 684 MOS Device Electronics

ECE 685 Nanoelectronics

ECE 699 Sensor Device Technology

ECE 780 Radio Frequency Electronics

Space-Based Systems (1)

- Required Course:

ECE 590 Small Spacecraft Design and Engineering

Two courses from the following list:

Space:

- ECE 513 Applied Electromagnetic Theory
- ECE 530 Sensor Engineering
- ECE 550/SYST 520 System Engineering Design
- ECE 699 Small Satellite Development

Space-Based Systems (2)

Choose two out of the three groups of courses listed below, and then take at least two courses from each of the selected groups (4 courses minimum; taking other courses from all three groups encouraged):

Communications and Signals:

ECE 528 Introduction to Random Processes in Electrical and Computer Engineering

ECE 535 Digital Signal Processing

ECE 630 Statistical Communication Theory

ECE 639 Satellite Communications

ECE 699 Software Defined Radio

ECE 754 Optimum Array Processing I

Space-Based Systems (3)

Control:

ECE 521 Linear Systems and Control

ECE 620 Optimal Control Theory

ECE 622 Kalman Filtering with Applications

ECE 627 Adaptive Control

Embedded Systems:

ECE 511 Microprocessors

ECE 545 Digital System Design with VHDL

ECE 612 Real-Time Embedded Systems

ECE 615 Software/Hardware Codesign

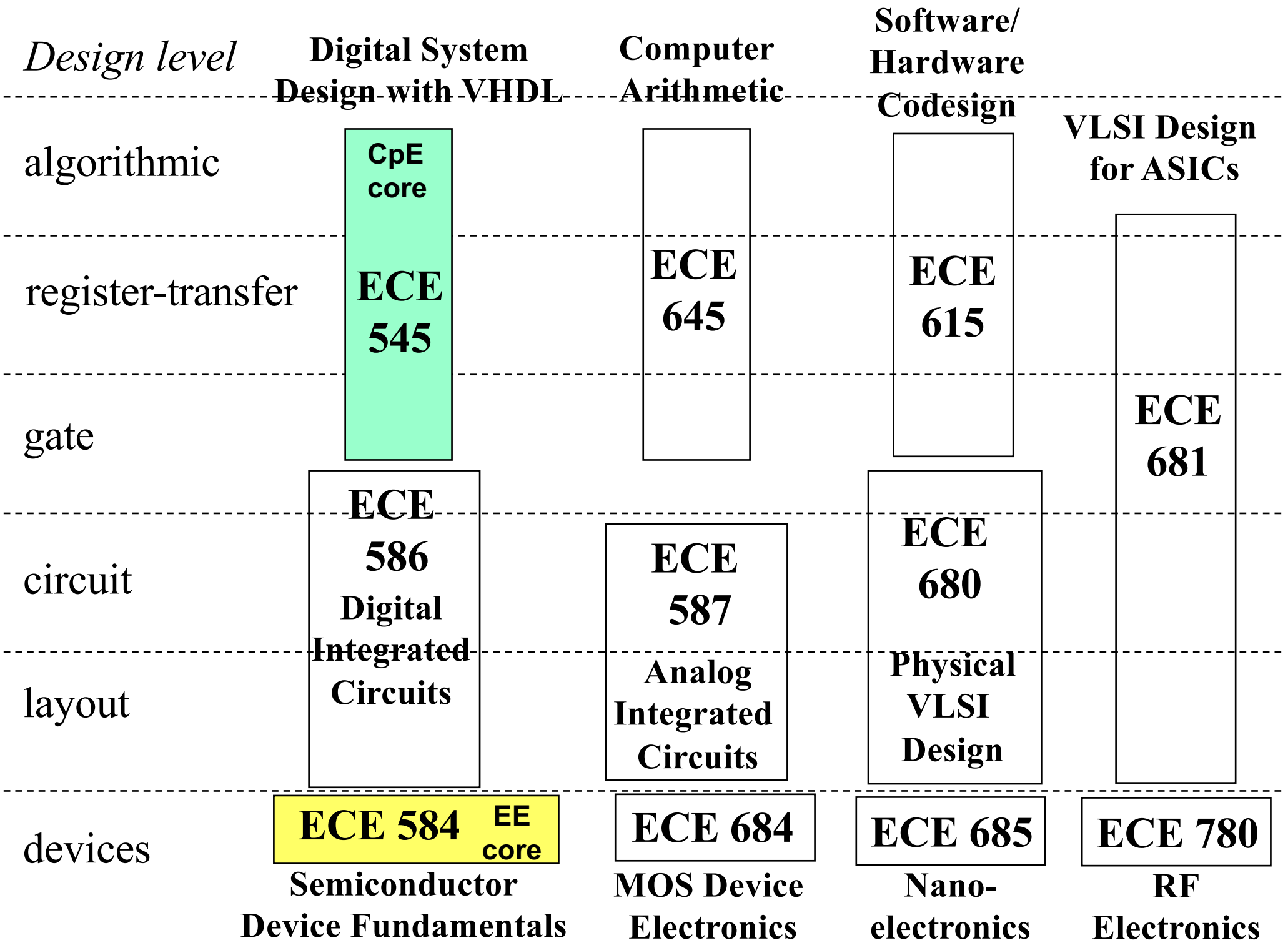
Bioengineering

- BENG 501 Bioengineering Research Methods
- ECE 521 Linear Systems and Control
- ECE 526/BENG 525 Neural Engineering
- ECE 530 Sensor Engineering
- ECE 535 Digital Signal Processing
- ECE 537 Introduction to Digital Image Processing
- BENG 538/ECE 538 Medical Imaging
- ECE 542 Computer Network Architectures and Protocols
- BENG 551 Translational Bioengineering
- ECE 590 Biomedical Signal Processing
- ECE 620 Optimal Control Theory
- ECE 621 Systems Identification
- ECE 622 Kalman Filtering with Applications
- BENG 636 Advanced Biomedical Signal Processing
- ECE 699 Advanced Topics in Biomedical Signal Processing
- ECE 734 Detection and Estimation Theory
- BENG 738 Advanced Medical Image Processing
- ECE 738 Advanced Digital Signal Processing
- ECE 754 Optimum Array Processing I

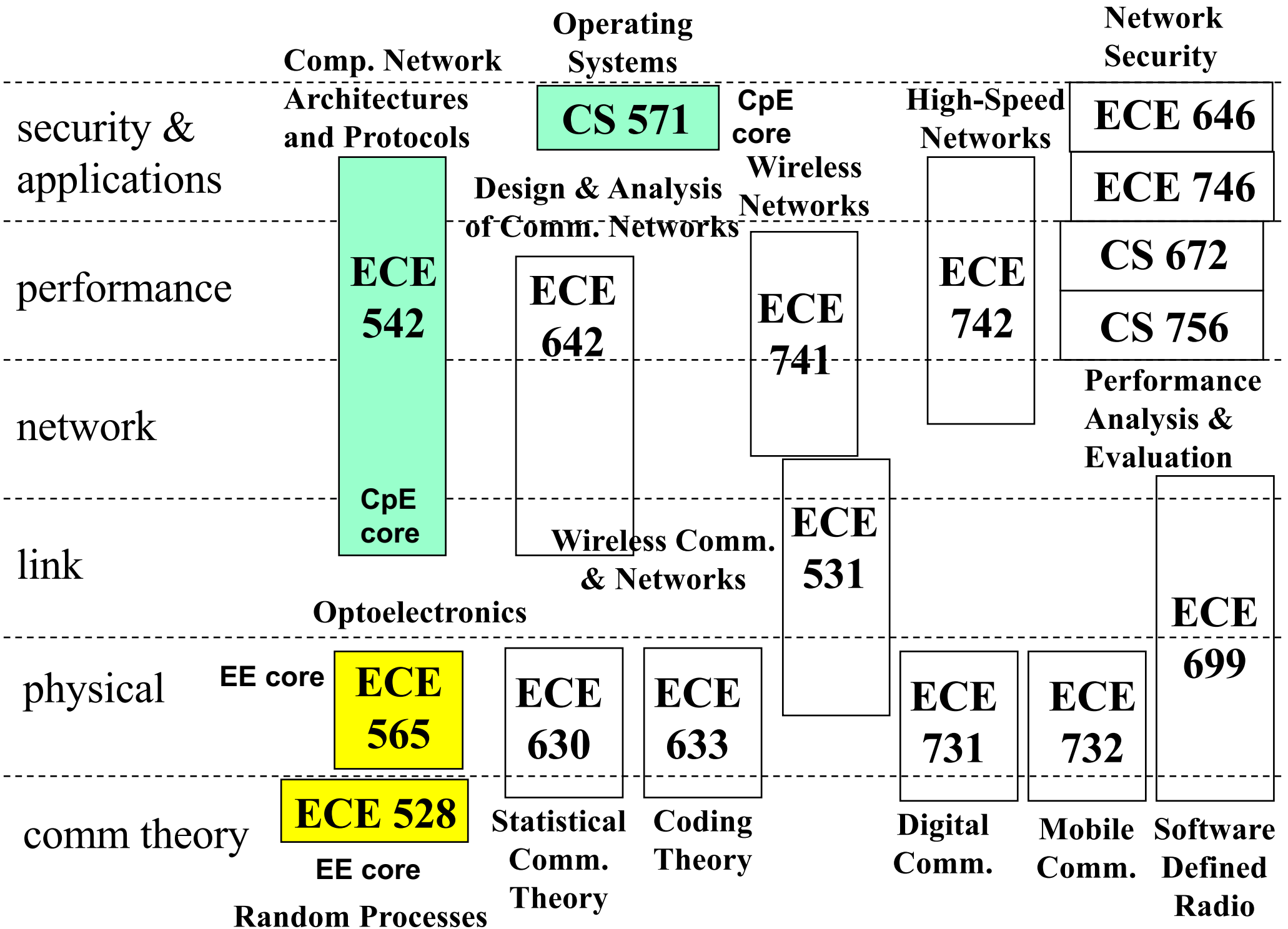
MS CpE
Specialization Areas

Summary

	CpE Digital Systems Design	CpE Microprocessors and Embedded Systems
Pre-Approved Electives	ECE 545 Digital System Design with VHDL ECE 586 Digital Integrated Circuits ECE 615 Software/Hardware Codesign ECE 645 Computer Arithmetic ECE 681 VLSI Design for ASICs ECE 682 VLSI Test Concepts ECE 740 DSP Hardware Architectures	ECE 510 Real-Time Concepts ECE 511 Microprocessors ECE 590 Mobile Systems & Apps ECE 611 Advanced Microprocessors ECE 612 Real-Time Embedded Systems ECE 615 Software/Hardware Codesign ECE 699 Green Computing and Heterogeneous Architectures
Suggested Electives	ECE 584, 684, … (technology) ECE 511, 611, … (microprocessors) ECE 646, 746, 747 … (applications)	CS 540, 583 (languages, algorithms) CS 635 (parallel machines) ECE 542, 642, 742 (networks) ECE 645, 681 (digital design) ECE 548 (sequential mach. theory) ECE 699 (advanced mobile systems) ECE 590 (small spacecraft design)
Professors	K. Gaj, H. Homayoun, J.-P. Kaps, A. Sasan	X. Chen, H. Homayoun, J.-P. Kaps, P. Pachowicz, C. Sabzevari, A. Sasan


Design level
Digital System Design with VHDL
Computer Arithmetic
Software/ Hardware Codesign
VLSI Design for ASICs
algorithmic
register-transfer
gate
circuit
layout
devices
CpE core
ECE 545
ECE 645
ECE 615
ECE 681
ECE 586 Digital Integrated Circuits
ECE 587 Analog Integrated Circuits
ECE 680 Physical VLSI Design
ECE 584 EE core
ECE 684
ECE 685
ECE 780
Semiconductor Device Fundamentals
MOS Device Electronics
Nano-electronics
RF Electronics

	CpE Computer Networks	CpE Network and System Security
Pre-Approved Electives	ECE 528 Random Processes in ECE ECE 531 Introduction to Wireless Communication & Networks ECE 542 Computer Network Architectures and Protocols ECE 633 Coding Theory ECE 642 Design and Analysis of Computer Networks ECE 646 Cryptography and Computer Network Security ECE 741 Wireless Networks ECE 742 High-Speed Networks	ECE 508 Internet of Things ECE 542 Computer Network Architectures and Protocols ECE 646 Cryptography and Computer Network Security ECE 746 Advanced Applied Cryptography ECE 747 Cryptographic Engineering ISA 656 Network Security
Suggested Electives	CS 672, CS 756 (performance) ECE 746, 747 (security) ECE 511, 611 (microprocessors) ECE 531, 630, 633, 731, 732, 733, 737, 739 (communications)	ISA 562, 564, 674, 765, 767 (network security) ECE 642, 741, 742 (computer networks) ECE 545, 645 (hardware implementations) ECE 511, 611 (microprocessors)
Professors	B.L. Mark, B. Jabbari, K. Zeng	K. Gaj, J.-P. Kaps, J. Jones, A. Sasan


security & applications
performance
network
link
physical
comm theory
Comp. Network Architectures and Protocols
Operating Systems
CS 571
CpE core
High-Speed Networks
Network Security
ECE 646
ECE 746
CS 672
CS 756
Design & Analysis of Comm. Networks
Wireless Networks
ECE 542
CpE core
ECE 642
ECE 741
ECE 742
Performance Analysis & Evaluation
Wireless Comm. & Networks
ECE 531
Optoelectronics
EE core
ECE 565
ECE 630
ECE 633
ECE 731
ECE 732
ECE 699
ECE 528
EE core
Random Processes
Statistical Comm. Theory
Coding Theory
Digital Comm.
Mobile Comm.
Software Defined Radio

	CpE Digital Signal Processing	CpE Internet of Things
Pre-Approved Electives	ECE 527 Learning From Data ECE 531 Introduction to Wireless Communications and Networks ECE 535 Digital Signal Processing ECE 537 Introduction to Digital Image Processing ECE 545 Digital System Design with VHDL ECE 615 Software/Hardware Codesign ECE 645 Computer Arithmetic ECE 699 Software-Defined Radio ECE 738 Advanced Digital Signal Processing ECE 740 DSP Hardware Architectures	ECE 508 Internet of Things ECE 510 Real-Time Concepts ECE 511 Microprocessors ECE 530 Sensor Engineering ECE 542 Computer Network Architectures and Protocols ECE 612 Real-Time Embedded Systems ECE 633 Coding Theory ECE 646 Cryptography and Computer Network Security ECE 746 Advanced Applied Cryptography
Suggested Electives	ECE 681 (ASIC) ECE 511, 611 (microprocessors) ECE 528 (math background) ECE 635, 754 (advanced DSP) ECE 731, 735 (applications)	ECE 527 (machine learning) ECE 537 (image processing) ECE 642, 742 (networks) ECE 645, 681 (digital design) ECE 611 (microprocessors)
Professors	A. Cohen, K. Gaj, K. Hintz, B. Mark, J. Nelson, K. Wage	K. Gaj, K. Hintz, J.-P. Kaps, P. Pachowicz, A. Sasan

Graduate Coordinators

MS CpE: Dr. Kris Gaj **MS EE: Dr. Bijan Jabbari**

Responsibilities:

- **initial interviews with the potential candidates**
  helping them to choose the right specialization area
- **keeping a record of students pursuing particular**
  specialization areas and graduating within
  a given specialization area
- **approving transfers between two specialization areas**
- **dealing with any exceptional circumstances**

Transfers and Degree Requirements

Transfer between Programs

- possible only after one semester of studies at GMU
- requires permission from the directors of the proposed and the current programs
- especially easy within the ECE Department, i.e., between the MS EE and MS CpE programs
- application form available at http://registrar.gmu.edu/wp-content/uploads/GCP.pdf

Transfer of Credit

In order to be applied to a given specialization area, all course credits transferred from

- **other universities**
- **non-degree status**

must be approved by the student's advisor prior to being presented for the final approval to the Department Chair.

Limitations:

- up to 12 credit hours, including courses taken at GMU in non-degree status
- all courses taken within 6 years of first enrollment at GMU
- grade of B or better

Plan of Study

A tentative plan of study must be submitted by each student to the student's advisor and the main ECE office no later than before the end of the second semester in the degree program at GMU

Degree Requirements

- total degree GPA of 3.0 (B) or better
  (degree GPA takes into account only courses
  applied toward graduation)

- no more than two C grades applied toward graduation

- graduate students who receive grades of F in two courses,
  or nine credit hours of unsatisfactory grades (C or worse)
  are very likely to be dismissed from the university.
  Exceptions are extremely rare.

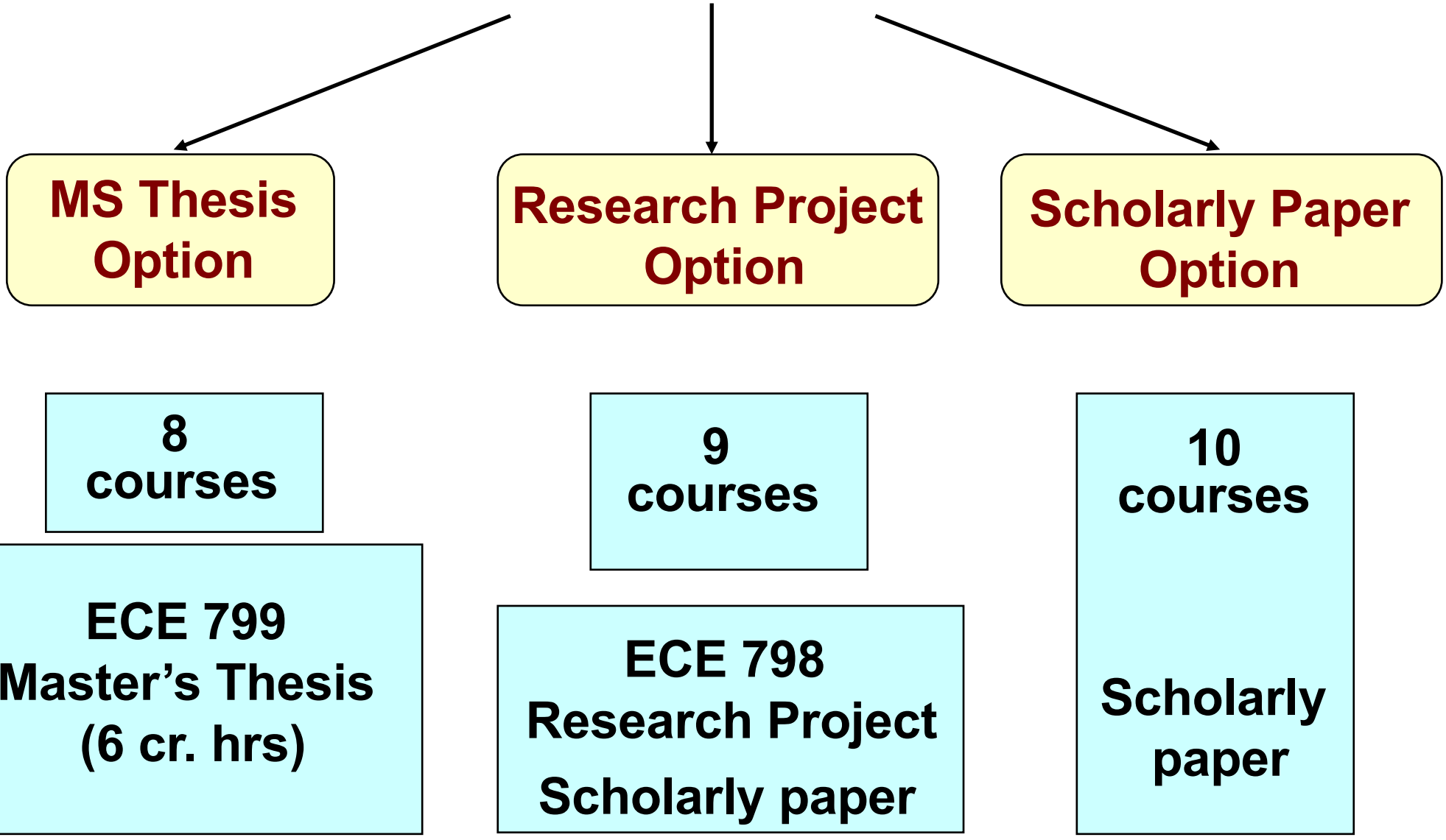
Seminar Requirement

- minimum of 6 approved seminars
- seminar types limited to
  - ECE Distinguished Series Seminars
  - ECE Departmental Seminars
  - PhD Thesis Presentations
  - PhD Seminars
- students must register for ECE 795 Engineering Seminar in their final semester of the program
- seminar attandance record signed by any faculty member attending the seminar
- final version submitted to the ECE Department
- back-up copies highly recommended

Choosing a Graduation Option within a Degree

MS EE & MS CpE

MS EE & MS CpE


MS Thesis Option
Research Project Option
Scholarly Paper Option
8 courses
ECE 799 Master's Thesis (6 cr. hrs)
9 courses
ECE 798 Research Project
Scholarly paper
10 courses
Scholarly paper

Master's Thesis (1)

Recommended for students interested in research and considering pursuing Ph.D. studies in the future

Topic typically proposed by a faculty member. Topics suggested by a student and/or related to the student's job allowed

RA positions available for selected topics

Student works closely with his/her academic advisor, for at least two semesters

Conference/journal publication expected as a result of the student's research

Master's Thesis (2)

Student must register (and pay for) at least 6 credit hours of ECE 799 Master's Thesis

After registering for ECE 799 once, the students must register for at least one credit hour of ECE 799 every Spring and Fall semester until they graduate

Oral defense open to general public in front of a three-faculty-member thesis committee

Temporary grades for all but last ECE 799 are IP = In Progress. These grades are changed after the successful defense to S – Satisfactory

Taking ECE 799 does not affect your GPA

Scholarly Paper (1)

Mandatory for all students who choose not to write a thesis

Students can fulfill the ECE 797 Scholarly Paper requirement through an individual, course-based project:

- in a **600 level or above** ECE course
- worth at least **20% of the course grade**
- a rigorous **written report** with substantial literature review
- a short, professional **oral presentation** with visual aids

List of courses that can be used to satisfy the scholarly paper requirement available on the ECE website

A successful scholarly paper recorded by awarding a satisfactory (S) grade for ECE 797 - Scholarly Paper

Scholarly Paper (2)

After completing 18 credit hours of graduate work, a student

1. **Chooses a 600-700 level course** to fulfill his/her ECE 797 requirement
2. **Registers for ECE 797 via Patriotweb** by first requesting an override from the Academic Programs Coordinator, Ms. Patricia Sahs (psahs@gmu.edu), before the last day to add classes
3. **Chooses a project topic** in consultation with the instructor
4. **Submits a single ECE 797 Entry Form**, signed by the instructor and the student, to the Main Office by the end of the 5th week of classes in a given semester
5. **Works** on a project **individually**
6. Submits **written report** and gives **short oral presentation**
7. Asks the instructor to fill and sign the **ECE 797 Evaluation Form**, and submits this form **to the main ECE Office**

Scholarly Paper (3)

The paper and presentation must follow accepted standards for

- English
- technical merit
- literature analysis
- citation of references
- GMU Honor Code

In order to pass, the student cannot receive an Unacceptable score for any evaluated outcome

Students are encouraged to sign for ECE 797 in their **last but one semester** which guarantees at least two attempts

If the reference is from a web source, the date of extracting the information must also be given as well as the URL

Rules regarding all written work

www.turnitin.com

- **Honor Code**
  - **Do not copy other student's work**
  - **Do not copy from the web without using quotation marks around copied work**
  - **Usually no more than 40% of content may be directly quoted**
  - **All quotations must have a reference cited**
  - **ECE students are sent to the honor court each year**

Based on Prof. Allnutt, TCOM Fall 2006 Orientation, telecom.gmu.edu, Aug. 2006

Rules regarding all writte

- **Honor Code**
  - **Do not copy other stu**
  - **Do not copy from ut using quotation mar ied work**
  - **Usually no % of content may be directly**
  - **All st have a reference cited**
  - **TCOM students are sent to the rt each year**

Possible end of Academic Career at GMU

Based on Prof. Allnutt, TCOM Fall 2006 Orientation, telecom.gmu.edu, Aug. 2006

Funding Your Education

Options available for international students

- Teaching Assistantships (TA)
- Research Assistantships (RA)
- Work on Campus

ECE Teaching Assistantships

10 or 20 hours per week
Salary + out-of-state to in-state tuition release

Grading, recitations, and labs for selected
ECE undergraduate and a few ECE and TCOM graduate courses

About 25 20-hr-per-week positions available each semester.
Applications need to be submitted to the ECE main office in the middle of the preceding semester
(deadlines and detailed procedures announced on the ECE website)

Preference given to senior students maintaining good GPA, with no C's or F's

Practical skills, such as documented knowledge of:
Matlab, PSpice, VHDL, C/C++, Python, Assembly languages, Xilinx Vivado, Xilinx ISE, ModelSim, FPGA boards, Microcontroller boards, measurement equipment, telecommunication equipment, etc. are very welcome

Research Assistantships

10 or 20 hours per week, salary + tuition

Research in the area of interest of a given ECE faculty member

Work on a research grant of a given professor

Candidates selected individually by each professor

Preference given to students maintaining good GPA,
with no C's or F's, with excellent grades in courses taught
by the given faculty member

Documented practical skills and experience in the area of research
of the given faculty member very welcome

MS Thesis option, earlier publications, and Ph.D. plans a plus

Very rarely granted to students in the first semester of their studies

Work on Campus

Up to 20 hours per week, salary, no tuition

For international students, the requirement to take
9 credit hours per semester to maintain the full-time status

Available positions

- department offices
- GMU library
- post-office
- computer labs
- bookstore
- cafeteria, etc.

Tips-n-Hints for Success

Graduate courses require much more outside work/study than undergraduate courses.
You may want to limit your enrollment to just one course if you work full time, and two courses if you work part time.

Higher level courses require a larger amount of work than lower level courses and build on material from the lower level courses.

Courses with projects are particularly time consuming.
Try to take no more than two such course per semester if possible.

Your degree is not a race. Get understanding, not just a credit.
Give yourself enough time for each subject.

Tips-n-Hints for Success – cont.

Plan your courses ahead. Talk with your advisor.
Make your plan of study coherent.
Avoid a mere hodge-podge of various courses.

Study groups are particularly helpful,
but be aware of the GMU honor code rules.

Start early; if you fail the first midterm or the first project,
it might be already impossible to catch up.

Talk with instructor and your advisor if you start to think
you might be having problems (academic or personal).

Listen to friends, believe faculty.

Thank you!

Questions???