May 19, 2010

MEMORANDUM

TO: Darryll Pines
    Dean, A. James Clark School of Engineering

FROM: Elizabeth Beise
    Interim Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to modify the curriculum of the M.S. in Telecommunications (PCC log no. 09084)

At its meeting on April 30, 2010, the Senate Committee on Programs, Curricula and Courses approved your proposal to modify the curriculum of the M.S. in Telecommunications. A copy of the approved proposal is attached.

The changes are effective Fall 2010. The School should ensure that the changes are fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

MDC/
Enclosure

cc: Alex Chen, Chair, Senate PCC Committee
    Sarah Bauder, Office of Student Financial Aid
    Reka Montfort, University Senate
    Erin Howard, Data Administration
    Donna Williams, Institutional Research & Planning
    Anne Turkos, Archives
    Linda Yokoi, Office of the Registrar
    Thomas Castonguay, Graduate School
    Gary Pertmer, A. James Clark School of Engineering
    Patrick O’Shea, Electrical and Computer Engineering
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM PROPOSAL

DIRECTIONS:
- Provide one form with original approval signatures in lines 1 - 4 for each proposed action. Keep this form to one page in length.
- Early consultation with the Office of the Associate Provost for Academic Planning & Programs is strongly recommended if there are questions or concerns, particularly with new programs.
- Please submit the signed form to Michael Colson, Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.
- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.

DATE SUBMITTED_4/14/2010

COLLEGE/SCHOOL_Clark School of Engineering__

DEPARTMENT/PROGRAM_Master's in Telecommunications Program

PROPOSED ACTION (A separate form for each) ADD ___ DELETE ___ CHANGE ___ X ___

DESCRIPTION (Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide old and new sample programs for curriculum changes.)

Updating of degree requirements for the Master's in Telecommunications program. Replacement of two required technical courses with a new course and selected course from a fixed list of regularly offered courses. Removal of project course requirement.

JUSTIFICATION/REASONS/RESOURCES (Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.)

The curriculum is outdated and needs to be better aligned with the field. See attached material for additional detail.

No implication for resources.

APPROVAL SIGNATURES

1. Department Committee Chair _K.J. Ray Liu, Professor and Associate Chair__ 4/14/10
2. Department Chair _Patrick O'Shea, Professor and Chair_John O'Lea_ 4/14/10
3. College/School PCC Chair _St. Albert McCullough, for D. Bigio__
4. Dean _St. Albert McCullough__ 2/21/10
5. Dean of the Graduate School (if required) __F. 30 2010
6. Chair, Senate PCC ___ 4/14/10
7. Chair of Senate ___
8. Vice President for Academic Affairs & Provost _Richard Frey__ 5/20/2010
MASTER'S IN TELECOMMUNICATIONS PROGRAM
CURRICULUM CHANGE PROPOSAL
REQUIRED INFORMATION

1. Current requirements as shown in the Graduate Catalog:

Requirements for completion of the M.S. degree include 33 credit hours of required coursework with a cumulative grade point average of at least 3.0/4.0. Specific coursework requirements include:

12 credit hours of technical coursework
- ENTS 620 Principles of Telecommunications
- ENTS 621 Design and Analysis of Telecommunication Systems
- ENTS 640 Telecommunication Networks
- ENTS 641 Communication Protocols

6 credit hours of coursework on telecommunications management
- ENTS 625 Management and Organizational Behavior in the Telecommunications Industry
- ENTS 632 Telecommunications Marketing Management

6 credit hours of coursework on telecommunications industry policy
- ENTS 630 The Economics of International Telecommunications Policy and Regulation
- ENTS 635 Decision Support Methods for Telecommunication Managers

3 credit hours for an ENTS 609 Telecommunications Project

Additionally, 6 credit hours of elective offerings are to be selected. Some of the classes include:

- ENTS 631 Competitive Strategies and Public Policies in Telecommunications
- ENTS 650 Network Security
- ENTS 653 PCS System Implementation
- ENTS 654 Optimization and Analysis of GSM Networks
- ENTS 656 Introduction to Cellular Communication Networks
- ENTS 657 Satellite Communications Systems
- ENTS 665 Advanced Wireless Communications Networks
- ENTS 670 Introduction to Business and Entrepreneurship
- ENTS 672 The Global Economic Environment
- ENTS 689 Special Topics in Telecommunications
* One or more Special Topics courses may be offered during and semester.

2. Proposed new requirements:

Requirements for completion of the M.S. degree include 30 credit hours of required coursework with a cumulative grade point average of at least 3.0/4.0 and the submission of a scholarly paper.

Technical Core Courses (12 credits):
- ENTS 622 Introduction to Digital Communication Systems
- ENTS 640 Telecommunication Networks
- ENTS 641 Communication Protocols
- At least one of the following selective core courses:
  o ENTS 653 PCS/AWS System Implementation
  o ENTS 654 Optimization and Analysis of GSM Networks
  o ENTS 656 Introduction to Cellular Communication Networks
  o ENTS 657 Satellite Communications Systems
  o ENTS 665 Advanced Wireless Communications Networks

Management Core Courses (12 credits)
- ENTS 625 Management and Organizational Behavior in the Telecommunications Industry
- ENTS 630 The Economics of International Telecommunications Policy and Regulation
- ENTS 632 Telecommunications Marketing Management
• ENTS 635 Decision Support Methods for Telecommunication Managers

Electives (6 credits) must be chosen from the following list (excluding the one selected for the technical core above):

• ENTS 631 Competitive Strategies and Public Policies in Telecommunications
• ENTS 650 Network Security
• ENTS 653 PCS System Implementation
• ENTS 654 Optimization and Analysis of GSM Networks
• ENTS 655 Digital Signal Processing
• ENTS 656 Introduction to Cellular Communication Networks
• ENTS 657 Satellite Communication Systems
• ENTS 660 Network Management
• ENTS 662 Telecommunication Innovations in Business
• ENTS 665 Advanced Wireless Communication Networks
• ENTS 670 Introduction to Business and Entrepreneurship
• ENTS 672 The Global Economic Environment
• ENTS 675 Network Planning and Design
• ENTS 689 Special Topics in Telecommunications (at least one will be offered each semester)
• ENTS 609 Telecommunications Project

3. Identification of and rationale for the changes:

a. Rationale:

The proposed change removes ENTS 620 and ENTS 621 as core courses, and adds a new course, ENTS 622. Additionally, it mandates taking one course out of ENTS 653, ENTS 654, ENTS 656, ENTS 657, or ENTS 665. This change to the technical core course requirements better aligns the current curriculum with the background of today’s graduate student and with the current trends in the telecommunications industry.

The proposed change also reduces the number of credits required for the degree from 33 to 30 credits by converting ENTS 609: Telecommunications Project into an elective. This conversion will help expedite time to degree completion and allows students to complete the scholarly paper requirement with more flexibility.

b. Detailed Summary:

Change to technical core course requirements:

The curriculum for the program was designed in 1992 and has remained relatively unchanged. The original curriculum was designed for local professional students with some telecommunications industry experience. At that time, the industry was in its very early stages of growth. Furthermore, most of the professionals did not have strong technical backgrounds, so they lacked knowledge in communications theory, basic concepts in signals and systems, and digital communications. Such fundamental concepts comprised the course content of ENTS 620 and ENTS 621. However, since 1992, both the status of the industry and of the entering student has changed. Telecommunications has undergone an unprecedented revolution, affecting wireless, networking, business, and management fields. At the same time, students who have been enrolling in the program have substantially deeper technical backgrounds. More than 95% of the students that are admitted to the program have a BS degree in Electrical Engineering, Computer Science or a related field.

As a result, the majority of the students do not need to take ENTS 620 or ENTS 621. In order to ensure that they have a rich program of study, the program allows students with the appropriate credentials to apply for course exemption waivers. When the waivers are granted, the students are approved to take
appropriate technical electives as replacements for ENTS 620 and ENTS 621.

Over time, these waivers have become commonplace. Recent semesters’ cancellations of ENTS 620 and ENTS 621 due to low enrollment lend further evidence to the obsolescence of these courses. At the same time, several of the electives have seen substantial increases in enrollment and have been approved to change from special topics courses to regularly offered courses. These examples illustrate the fact that a curriculum update is needed.

The newly proposed course, ENTS 622, is a compressed version of ENTS 620 and ENTS 621. It covers the basics of digital communications; however, 25% of the course consists of topics that were not covered in the syllabi of ENTS 620 or ENTS 621. These topics help address the advances in practical modern communication systems that have occurred since the early 1990s. In other words, ENTS 622 covers the fundamentals plus some updated material in one semester. This frees up one course in the degree requirements for a course that suits the 21st century telecommunications degree.

The freed up slot will be filled by one course from the following list: ENTS 653, ENTS 654, ENTS 656, ENTS 657, or ENTS 665. The purpose of this selectable core is to address the existing breadth in the critical area of wireless systems. These courses together cover wireless, cellular, and satellite communication systems. Students will be advised to choose a class that is appropriate for their academic and professional interests.

Therefore, under the new requirements, the ENTS student will still obtain a solid grounding in the basics of communications and systems but will also be able to have more instruction in wireless and modern systems, a necessity for telecommunications graduates in the 21st century.

Change to project requirement:

As mentioned above, the original curriculum was designed based on a cohort of local industry professionals. It was expected that these students would complete their projects while back on the job, and that the project would be of use to the company. Since our student population has widely diversified, it is no longer practical to require the project; thus, requiring students to take the additional three credits is unnecessary.

Instituting 30 credits plus a scholarly paper for the degree requirement better aligns this M.S. program with other M.S. non-thesis programs on campus. Students interested in project work will still have the option of registering for ENTS 609: Telecommunications Project as an elective.

4. A sample program under the proposed requirements:

Semester 1: ENTS 622, ENTS 640, ENTS 630
Semester 2: ENTS 656, ENTS 641, ENTS 625
Semester 3: ENTS 635, Elective
Semester 4: ENTS 632, Elective

5. Chart showing timetable of course implementation:

The following table shows the plans to practice the suggested new curriculum starting Fall 10 for four semesters. The courses are expected to repeat regularly each year.

<table>
<thead>
<tr>
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<th>Fall 10</th>
<th>Spring 11</th>
<th>Fall 11</th>
<th>Spring 12</th>
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<td>ENTS 630</td>
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6. New Courses:

ENTS 622. (VPAC proposal attached)

7. Deleted Requirements:

ENTS 620, ENTS 621, and ENTS 609

8. Other departments impacted by change:

No other departments are impacted by the proposed changes.

9. Students enrolled in the program prior to the curriculum change:

Students who enter the program in fall 2010 or later will graduate with the new curriculum.

Students who entered the program prior to fall 2010 will have the option of choosing the new curriculum or the old curriculum. To simplify administrative matters from their perspective, they will be encouraged to maintain status quo.

Regarding the technical core requirement for students who enrolled prior to fall 2010, students will be encouraged to graduate (de jure) under the old requirements. Since a large majority of these students were granted waivers for ENTS 620 and ENTS 621, they were required to take two technical electives as replacements. So, most of the students finishing up under the old requirements have had the practical (de facto) benefit of choices similar to the new requirements; that is, they were able to take courses such as those on the "selective core courses" list to fulfill the technical core requirement. Therefore, there should be no real need or benefit for them to choose the new requirements.

For the small numbers of students who were granted waiver only for ENTS 620, we have offered ENTS 689B, a course similar to ENTS 622. In recent years, there were no students who needed to take both ENTS 620 and 621.

Regarding the project requirement for students who enrolled prior to fall 2010, those students who have already registered for ENTS 609 and begun or completed their project work will be encouraged to graduate under the old requirements (i.e., project work and submission of a technical report/scholarly paper).
Course Prefix and Number: ENTS622  
Transcript Title: Intro Digital Comm Sys  
Title: Introduction to Digital Communication Systems  
Credits: Minimum 3 Maximum 3  
Repeatable to a maximum of 0 if content differs  
Hour commitment per week: Lecture: 3  
Internship:  
Discussion:  
Laboratory:  
Seminar:  
Can this course be waived through an AP exam? No  
Has this course been approved to fulfill a CORE distribution requirement? No  
Grading Method: Standard Graduate  
Formerly: ENTS689B  
Prerequisite(s):  
Corequisite(s):  
Recommended course(s):  
Restrictions: Restricted to ENTS majors. All non-majors will need to obtain permission from the department.  
Crosslisted with:  
Shared with:  
Credit will be given for only one of the following courses: ENTS689B, ENTS622  
Will this course be offered at another location or through an alternate delivery method? No  
Catalog Description: The objective of this course is to convey the principles of analog and digital communication systems design. Students will analyze the performance and relative merits of different modulation/demodulation, signal processing, and error control schemes in communication systems. The course provides an understanding of the design of modern digital communication systems.  
Reason for proposal/comments: The course content in ENTS 620 and ENTS 621 is largely based on fundamental material, some of which has become outdated. The necessary fundamentals can be condensed into one course.  
Early Warning Grades: No  
Inclement Weather Procedures: No  
Academic Integrity / Honor Pledge: No  
Accommodations for students with disabilities: No  
Learning Outcomes:  
Assessment Policy:  
Text/Resource Materials:  

Course Pedagogy and Format:  

For use by Registrar's Office only  
Effective Term:  
Repeat Table:  
Prereq pop-up:  
Entered/date:  
Verified:  

Dept. PCC Chair (print name, sign, date)  
Dept. Chair (print name, sign, date)  
College/School PCC Chair (print name, sign, date)  
Dean (print name, sign, date)  

Vice President for Academic Affairs & Provost  
Effective Term

Print vpac proposal
http://vpac.umd.edu/Proposal/printtable.cfm?Year=10&LogNo=52449&R...
ENTS 622 Introduction to Digital Communication Systems

Required Texts:

Course Objectives:
Understand the principles of analog and digital communication systems design. Analyze the performance and relative merits of different modulation/demodulation, signal processing, and error control schemes in communication systems. Understand the design of modern digital communication systems.

Prerequisites:
The student is expected to have completed a technical undergraduate degree, e.g., a B.S. in Engineering, Physics, Mathematics, including successful completion of courses in differential and integral calculus, differential equations, signals & systems (including Fourier series, Fourier transforms, convolution, properties of linear time-invariant systems), and probability theory (including random variables, cumulative distribution functions, probability density functions, functions of random variables, and moments of random variables).

Topics Covered:
- AM & FM: time and frequency representations, bandwidth requirements, detection, performance in the presence of noise.
- Digital signal modulation/demodulation: sampling theorem, quantization noise, PCM, signal constellations, PAM, QAM, PSK, FSK, CPFSK, MSK, GMSK, matched filter, optimum receiver, probability of bit error
- Linear predictive coding (LPC) and source coding
- Intersymbol interference (ISI) and equalization.
- Channel capacity and channel coding.
- Rayleigh fading channel model, frequency selectivity, signal diversity, OFDM, DSL, wireless LAN
- Spread spectrum digital communications – GSM, CDMA

Person who prepared this syllabus and date of preparation:
Dr. Sheldon Wolk, October 2008
Textbooks under consideration...one of the following:
   2. Rodger Ziemer & Roger Peterson, Introduction to Digital Communication 2nd Ed. Prentice Hall

Possible supplemental text:
   John G. Proakis, Contemporary Communications systems Using MATLAB, Cengage Engineering

Additional supplements:
   Numerous hand-outs