Graduate Certificate Proposal

Title: *Digital Communications*
Offered By: The Klipsch School of Electrical & Computer Engineering
College of Engineering

Introduction/Purpose

The College of Engineering proposes to offer a graduate certificate in the area of digital communications with our major market focus being on distance education. Communications focuses on the problem of transmitting information from one place to another through some medium (e.g., RF wireless). The proposed certificates will introduce students to the basic theory as well as the application of that theory. It should be noted that we are currently proposing to offer three related certificates (DSP and Telemetering in addition to the Digital Communications certificate discussed in this proposal) rather than just a single one because there are significant overlaps between these programs and, consequently, it will require no more faculty to support all three of them than it would to support just one. This is especially critical because we plan to make all of the classes required for these certificates available to distance education students and we would like to market the certificates to working engineers who are interested in expanding their expertise in one of these three areas.

The courses that we plan to include in these certificates have been offered by the College of Engineering for many years. This certificate will create a unique credential opportunity for engineering and technical professionals to receive an in-depth education focused entirely in one or more of these one core disciplines, enabling those individuals who seek a credential of this type to use New Mexico State University as a source.

Educational Objectives

The objectives of this program are:
- To provide technical professionals an opportunity to advance their careers through advanced education in digital communications,
- To develop and improve relationships with the College of Engineering's constituencies by offering a program that addresses a known need for professional graduate-level development.
- To provide an opportunity for non-traditional students to consider advancing their education in areas that will foster their career development.
- To enable program students to become aware of certificate faculty research.

Market/Need

Our market is engineers and technical professionals who are interested in increasing their expertise in these important technical areas. We will use our current approach of marketing through our own internal mechanisms as well as the marketing resources available through the College of Extended Learning. The need for engineers with a strong understanding of in advanced digital communications/Telemetering/DSP techniques has

been pointed out numerous times by members of the Klipsch Academy, the outside advisory body for Electrical & Computer Engineering here at NMSU. We believe that this program may be marketed to students while they are undergraduates and then entered into after they have accepted employment.   Since the major program focus will be distance-based, enrolment is not limited by a student's location.   Additionally, the College of Engineering has strong employer relationships that may also be used to encourage students to enter this program. A key strategy is to encourage students to enter the certificate program and establish a grade point average that will allow them to apply for admission to the full master's program.   Attached are letters of support that demonstrate the perceived need for this certificate program. Such letters indicate the intensity of interest by employers.

Advising

We anticipate advising will be relatively simple. Each program as outlined below has two required courses and two electives. The students will generally need to take the two required classes first since they are prerequisites of most of the elective classes. The two required classes are offered once a year. We anticipate groups of students will form and go through the program in informal cohorts thus making advising more efficient. Students will be advised by a regular faculty member who is within the certificate faculty. The program will have a web site that will be linked from the College of Engineering Distance Education web site with all academic information.

Admissions

Students applying to be admitted to the Digital Communications certificate program must meet the same admissions criteria as students admitted into the Master of Science in Electrical Engineering. An undergraduate degree in electrical engineering with a GPA of 3.0 or higher is the norm. An undergraduate GPA as low as 2.5 will be considered. Students with undergraduate degrees in disciplines other than electrical engineering will be considered, provided they have completed the following undergraduate deficiency courses (or their equivalents):

Course Num & Credits	Title	Catalog Description
E E 210 4 credits	Engineering Analysis I	The application of linear algebra and matrices, probability, random variables and random processes to solve problems in electrical engineering. Applications to be covered include probabilistic modeling of electrical/electronic systems and an introduction to Mat lab. Prerequisite(s): C or better in EE 161 and MATH 192G.
E E 312 3 credits	Signals and Systems	Continuous-and discrete-time signals and systems. Time-and frequency-characterization of signals and systems. Transform-domain methods including Fourier-, Laplace-, and z-transforms. Prerequisite(s): C or better in EE 210, EE 280,

		and Math 392.
MATH 392	Introduction to Ordinary Differential Equations	Introduction to differential equations and dynamical systems with emphasis on modeling and applications. Basic analytic, qualitative and numerical methods. Equilibria and bifurcations. Linear systems with matrix methods, real and complex solutions. Prerequisite: C or better in MATH 192G or B or better in MATH 236.

Certificate-only seeking graduate students who are not currently enrolled in either a master's or doctoral degree program will be admitted into a separate classification such as "certificate graduate students." Students enrolled in certificate programs or who successfully complete a certificate program within a 5 year period and who wish to enter a related graduate degree program must re-apply to the degree program.

Students who are currently enrolled in a degree program at NMSU who wish to pursue an approved graduate certificate program must apply for admission to the certificate program prior to completing half of their required degree credits.

Transfer Credits

Students enrolled in certificate programs cannot transfer credits from another institution towards the completion of the certificate program offered by New Mexico State University. However, they can transfer credits taken in a certificate program of NMSU into a graduate degree program of the Klipsch School of Electrical and Computer Engineering, provided that a grade of B- or higher is earned in the course and the course logically fits into the student's program of study, as determined by their graduate advisor. There is no limit to the number of credits that can be transferred into a graduate program of the Klipsch School. The time limit on course transfer is 5 years after completion of the certificate.

Faculty Coordinator

The overall certificate program in Digital Communications will be managed by Dr. Deva Borah, Associate Professor Klipsch School of Electrical & Computer Engineering dborah@nmsu.edu, 575-646-3357.

Core Faculty Supporting the Certificate Program
- Dr. Deva Borah
- Dr. Joerg Kliewer

Multiple Certificates

Students would be allowed to earn multiple certificates; double counting of courses is not allowed, however. In the event that a student has already taken a class for one certificate that is required for a different one, that student would be allowed to substitute an elective class for the already-completed required class. Furthermore, it the student chooses to pursue a Masters degree at NMSU, the classes taken as part of our certificate programs will count towards this degree, subject to NMSU and graduate school requirements.

Academic Content

A 3.0 minimum cumulative GPA in four courses as described below will be required for award of this certificate.

Required: (6 credits)
E E 571 Random Signal Analysis
E E 581 Digital Communications

Electives: (6 credits out of the following)
E E 545 Digital Signal Processing II
E E 568 Wireless Networks
E E 572 Coding theory
E E 573 Signal Compression
E E 582 Digital Communications II
E E 583 Personal Communications
E E 586 Information Theory

Course Descriptions

E E 545. Digital Signal Processing II 3 cr.
Non-ideal sampling and reconstruction, oversampling and noise shaping in A/D and D/A, finite word length effects, random signals, spectral analysis, multirate filter banks and wavelets, and applications. Recommended preparation is E E 395 or equivalent.

E E 568. Wireless Networks 3 cr.
Challenges of node mobility and wireless channels. Protocols and architectures for wireless data communications. Modeling and simulation of wireless networks. Advanced topics in wireless networks from current literature. Recommended preparation is EE 469 or equivalent.

E E 571. Random Signal Analysis 3 cr.
Application of probability and random variables to problems in communication systems, analysis of random signal and noise in linear and nonlinear systems. Recommended preparation is E E 210 or equivalent.

E E 572. Coding Theory 3 cr.
This class addresses error control techniques for digital transmission and storage systems. It introduces material on basic coding bounds, linear and cyclic block codes, Reed-Solomon codes, convolutional codes, maximum likelihood decoding, maximum a posteriori probability decoding, factor graphs, low density parity check codes, turbo codes, iterative decoding. Also, applications to data networks, space and satellite transmission, and data modems are discussed. Prerequisite: E E 571 or consent of instructor.

E E 573. Signal Compression 3 cr.
Fundamentals of information source encoding and decoding. Includes information theory bounds on source coding, lossless coding algorithms, scalar quantizing and vector quantizing. Prerequisite: E E 571.

E E 581. Digital Communications I 3 cr.
Techniques for transmitting digital data over commercial networks. Topics include baseband and bandpass data transmission and synchronization techniques. Recommended preparation is E E 497 or equivalent. Prerequisite(s): E E 571.

E E 582. Digital Communication Systems II 3 cr.
Continuation of E E 581. Topics include coding, synchronization techniques, and adaptive equalization. Prerequisite: E E 581.

E E 583. Personal Communications Systems 3 cr.
Cellular systems, propagation, modulation, multiple access, and spread spectrum techniques for mobile radio, as well as smart antennas, networking, and standards for wireless systems. Prerequisite: E E 571.

E E 586. Information Theory 3 cr.
This class is a study of Shannon's measure of information and discusses mutual information, entropy, and channel capacity, the noiseless source coding theorem, the noisy channel coding theorem, channel coding and random coding bounds, rate-distortion theory, and data compression. Prerequisite(s): E E 571 or STAT 515. Crosslisted with: MATH 509