LONG SIGNATURE SHEET

UNC CHARLOTTE

Proposal Number: ECGR 9-15-10

Proposal Title New Graduate Course on Wireless Sensor Networks

Originating Department Electrical and Computer Engineering

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE__X__ UNDERGRADUATE & GRADUATE___
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
			Approved	**DEPARTMENT CHAIR**
			Approved	**COLLEGE CURRICULUM COMMITTEE CHAIR** Engineering Graduate
12/6/10	12/21/10	12/21/10	Approved	**COLLEGE FACULTY CHAIR**
12/21/10	1/3/11	1/3/11	Approved	**COLLEGE DEAN**
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR** (for undergraduate courses)
1-26-10	2-1-11	2-4-11	Approved	**GRADUATE COUNCIL CHAIR** (for graduate courses) Rob Roy McGregor
			Approved	**FACULTY GOVERNANCE SECRETARY** (noting Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

University of North Carolina at Charlotte

Proposal for New Graduate Course

Course and Curriculum Proposal from: Department of Electrical and Computer Engineering

Title: New Graduate Course on Wireless Sensor Networks

A. PROPOSAL SUMMARY AND CATALOG COPY

1. <u>SUMMARY:</u> The Department of Electrical and Computer Engineering proposes to add a new elective course to the graduate curriculum: ECGR 6189/8189, Wireless Sensor Networks.

2. <u>PROPOSED CATALOG COPY</u>: **ECGR 6189. Wireless Sensor Networks (3)**. Prerequisite: Graduate standing and knowledge of (a) fundamentals of computer networking, (b) probability and random variables, and (c) C/C++ programming, or permission from the department. This course will provide the fundamental principles of wireless sensor networks with emphasis on networking protocols and information processing aspects. The course will review basic principles of multi-hop wireless networks and discuss the specific design challenges for the development of networking protocols and applications with wireless sensors. Students will be going through hands-on tutorials and design projects with programmable wireless sensors. Credit will not be given for ECGR 6189 where credit has been given for ECGR 8189. *(on demand)*
<u>PROPOSED CATALOG COPY</u>: **ECGR 8189. Wireless Sensor Networks (3)**. See ECGR 6189 for Course Description. Credit will not be given for ECGR 8189 where credit has been given for ECGR 6189.

B. JUSTIFICATION.

1. <u>Identify the need addressed by the proposal and explain how the proposed action meets the need:</u> In recent years there has been a surge of interest on small low-power wireless sensors that can sense, process, and autonomously configure into a wireless mesh network to perform distributed monitoring operations. This has stemmed from developments in enabling technologies such as wireless systems, sensors and actuators, and silicon integration. In addition to their transformative applications in important areas such as homeland security, infrastructure monitoring, industrial monitoring/control, health care, and environmental monitoring, the field of wireless sensor networks (WSN) is also important from a theoretical standpoint as they involve unique design issues in achieving reliable and long-lasting operations under extremely tight energy and hardware constraints. Consequently, the field of wireless

sensor networks has emerged as a popular and important subject in graduate programs in electrical and computer engineering. The proposed course is designed to present the fundamental principles of wireless sensor systems, existing design solutions, current and ongoing research problems, as well as provide hands-on experience on using wireless sensors for designing monitoring applications with WSNs. The course will prepare graduate students to be effective in the workforce as well enable them to perform advanced research and developments on this rapidly emerging area.

2. <u>Discuss prerequisites/corequisites for course(s) including class-standing:</u>
   Prerequisites: Graduate standing and prior knowledge of (a) fundamentals of computer networking, (b) probability and random variables, and (c) C/C++ programming.

3. <u>Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended:</u> The course numbering ECGR 6189/8189 is consistent with the level of academic advancement of graduate students, for whom it is intended.

4. <u>In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction:</u> Presently, several advanced graduate courses in telecommunications exist (ECGR 6120 Wireless Communication and Networking, ECGR 6121 Advanced Theory of Communications I, ECGR 6122 Advanced Theory of Communications II, and ECGR6187 Modeling and Analysis of Communication Networks) that cover general topics in wireless communications and networking. However, no existing graduate course systematically covers the fundamentals of wireless sensor networks and provides in-depth knowledge on their design issues and approaches. The proposed course complements the existing courses on wireless communications with an emphasis on the theory and principles wireless sensor networks, including practical training with them. The proposed course will be an important component of the graduate curriculum on telecommunications in ECE Department. This course can effectively motivate students' interest in further studies of advanced graduate courses in telecommunications and prepare graduate students to be effective in the workforce in premier companies and for research in the field of wireless communications and networking.

C. IMPACT.

1. <u>What group(s) of students will be served by this proposal?</u> This course will interest graduate students in electrical and computer engineering with interest in wireless systems. Typically, graduate students in their second semester or later will take this course, after they have taken some fundamental courses on wireless communications.

2. <u>What effect will this proposal have on existing courses and curricula?</u>
   The proposed course will complement the existing courses on wireless communications in Electrical and Computer Engineering and effectively prepare

graduate students for further studies in advanced graduate courses in telecommunications.

    a. <u>When and how often will added course(s) be taught?</u> It will be offered on demand. According to the current demand and scheduling of courses, it will be offered in alternate years.

    b. <u>How will the content and/or frequency of offering of other courses be affected?</u> No effect expected.

    c. <u>What is the anticipated enrollment in course(s) added (for credit and auditors)?</u> Typical enrollment expected to be 20-30 students.

    d. <u>How will enrollment in other courses be affected?</u> None expected.
       <u>How did you determine this?</u> Graduate students in electrical and computer engineering routinely express interest to have this course in the curriculum. Because of this interest, the course was offered as a special topics course in the past few years, when it served to fill this void adequately.

    e. <u>If course(s) has been offered previously under special topics numbers, give details of experience including number of times taught and enrollment figures.</u> The proposed course is a modified form of a special topic course that was taught in the following semesters with enrollments as shown:
Spring 2006, Enrollment: 27 (25 M.S., 2 Ph.D.)
Fall 2007, Enrollment: 20 (15 M.S., 5 Ph.D.)
Fall 2009, Enrollment: 16 (12 M.S., 4 Ph.D.)

    f. <u>Identify other areas of catalog copy that would be affected, e.g., curriculum outlines, requirements for the degree, etc.</u> Crosslisting ECGR 6189 and ECGR 8189 in the graduate catalog.

D. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

When added resources are not required, indicate "none". For items which require "none" explain how this determination was made.

  1. Personnel
    a. Specify requirements for new faculty, part-time teaching, student assistant and/or increased load on present faculty: None.
    b. List by name qualified faculty members interested in teaching the course(s): Asis Nasipuri

  2. Physical Facility: None

3. Equipment and Supplies: Commercial off-the-shelf wireless sensors are available in the Wireless Communications and Signal Processing Laboratory in the Electrical and Computer Engineering department. These sensors will be used for the tutorials and course projects.

4. Computer: Windows PCs are required. Student owned personal computers or laboratory desktops, such as those available in the Wireless Communications and Signal Processing Laboratory in the Electrical and Computer Engineering department will meet this need. No additional computer resources are needed.

5. Audio-Visual: None

6. Other Resources: None

7. Indicate source(s) of funding for new/additional resources required to support this proposal: None required

E. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

1. Library Consultation
Indicate written consultation with the Library Reference Staff at the departmental level to insure that library holdings are adequate to support the proposal prior to its leaving the department. (Attach copy of *Consultation on Library Holdings*).

2. Consultation with other departments or units
N/A

F. INITIATION AND CONSIDERATION OF THE PROPOSAL

1. Originating Unit
Briefly summarize action on the proposal in the originating unit including information on voting and dissenting options.
Approved per attached signatures

2. Other Considering Units
Briefly summarize action on the proposal by each considering unit including information on voting and dissenting options.
N/A

Course Syllabus

1. Course Number and Title:
   ECGR 6189/8189. Wireless Sensor Networks

2. Course Description (Catalog Description)**:**
   ECGR 6189. Wireless Sensor Networks (3). Prerequisite: Graduate standing and knowledge of (a) fundamentals of computer networking, (b) probability and random variables, and (c) C/C++ programming, or permission from the department. This course will provide the fundamental principles of wireless sensor networks with emphasis on networking protocols and information processing aspects. The course will review basic principles of multi-hop wireless networks and discuss the specific design challenges for the development of networking protocols and applications with wireless sensors. Students will be going through hands-on tutorials and design projects with programmable wireless sensors. Credit will not be given for ECGR 6189 where credit has been given for ECGR 8189. *(on demand)*
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3. Prerequisites:
   Prerequisite: Graduate standing and knowledge of (a) fundamentals of computer networking, (b) probability and random variables, and (c) C/C++ programming.

4. Course Objectives:
   The purpose of this course is to provide the capabilities, applications, principles of operation, design challenges, and research issues on wireless sensor networks. Emphasis will be given to the networking protocols and information processing aspects. A set of tutorials is included in this course to provide practical training on programming with wireless sensors.

5. Instructional Method:
   The course is in lecture format. Practical experience will be provided as tutorials in the lecture room.

6. Evaluation:
   Grading policy: A=90-100%, B=80-90%, C=70-80%, U=below 70%
   Grades will be based on the student's performance on homework assignments, two midterm examinations, one presentation, and programming based research projects. Presentation and research topics must be approved by instructor. Students will be evaluated on the following:
      Homework assignments and paper critiques=20%,
      Mid-term examinations=30%,
      Presentation=10%,
      Software projects=40%

7. Policies that apply to this course:

i) The course has theory and practical content. In addition, students will be learning to search and read papers, critique them, and present their ideas.

- Various papers will be cited as reading material on different topics.
- Students should be comfortable with C/C++ programming as projects need to be done using *MICAz* or *mica2* motes using *nesC*, which is a code similar to C. Tutorials and samples of code will be provided by the instructor.
- Although presentations and research projects will be done in groups, each student will have an independent component in it. This has to be made clear by each group while planning the presentation or research project.
- Guidelines, information, and sample code (where applicable) will be provided through the course web site for presentations and projects.
- Students are urged to be productive. Good ideas may be extended to theses or publications.

ii) Students have the responsibility to know and observe the requirements of the *UNCC Code of Student Academic Integrity (http://legal.uncc.edu/policies/ps-105.html)*. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

8. Probable Textbooks:

There is no prescribed textbook for the course. Course material will consist of research papers as cited by the instructor.

The following textbooks may be useful, although not required for the course:
1. "*Wireless Sensor Networks: An Information Processing Approach*", F. Zhao and L. Guibas, Morgan Kaufmann, 2004
2. "*Wireless Sensor Networks*", edited by C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Kluwer, 2004.

9. Topical Outline:

The course will cover the following topics:
- Introduction: technology, scope, applications.
- Multihop wireless networks: wireless transmission basics, wireless networking challenges – medium access, routing.
- MAC in sensor networks: assumptions, S-MAC, IEEE 802.15.4
- Routing in sensor networks: energy aware routing, geographic routing, attribute based routing
- Localization and time synchronization in sensor networks
- Distributed data processing in sensor networks.
- Current issues

UNCCHARLOTTE
J. Murrey Atkins Library

CONSULTATION ON LIBRARY HOLDINGS

To: Alison Bradley, Engineering Librarian (adbradle@uncc.edu)
From: Asis Nasipuri (anasipur@uncc.edu)
Date: September 28, 2010
SUBJECT: ECGR 6189/8189 CONSULTATION ON LIBRARY HOLDINGS

PROPOSED CATALOG COPY: ECGR 6189. Wireless Sensor Networks (3). Prerequisite: Graduate standing and knowledge of (a) fundamentals of computer networking, (b) probability and random variables, and (c) C/C++ programming, or permission from the department. This course will provide the fundamental principles of wireless sensor networks with emphasis on networking protocols and information processing aspects. The course will review basic principles of multi-hop wireless networks and discuss the specific design challenges for the development of networking protocols and applications with wireless sensors. Students will be going through hands-on tutorials and design projects with programmable wireless sensors. Credit will not be given for ECGR 6189 where credit has been given for ECGR 8189. *(on demand)*

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley   **Date: 9/28/10**

Please Check One:
    Holdings are superior
    Holdings are adequate   ✗
    Holdings are adequate only if Dept. purchases additional items.   ____
    Holdings are inadequate   ____

Comments: Library holdings should be adequate to support student research in this area. We provide access to relevant databases and online journals such as IEEE Xplore, ACM Digital Library, Electronics & Communications Abstracts, and Computer and Information Systems Abstracts. For students whose research interests require access to additional material, we are able to borrow materials from other libraries through various consortial agreements.

_____
Evaluator's Signature

9/28/10
_____
Date