R·I·T	**Rochester Institute of Technology** **Golisano College of Computing and Information Sciences** **Department of Networking, Security, and Systems** **Administration**

4050-582/782 Wireless Ad-Hoc/Sensor Networks

<Winter 2005-2006> Course Syllabus

REMINDER: The information presented in this syllabus is subject to expansion, change, or modification during the quarter.

Instructor:	**Office Hours:**
Name: Dr. Xiaojun Cao Office: Bldg. 70-2321 ☎ 475 –4475 ✎ Email address xiaojun.cao@rit.edu	Check web page and notice board outside of office or other times by appointment
Name: Dr. Nirmala Shenoy Office: Bldg. 70-2303 ☎ 475 –4887 ✎ Email address ns@it.rit.edu	Check web page and notice board outside of office or other times by appointment
Course Website: **http://mycourses.rit.edu**	

Class meeting time and location

> 4050-582/782-70 Tuesday and Thursday 6:00 pm to 7:20 pm 86-1100

Course Text and Materials

> Recommended:
> 1. Holger Karl and Andreas Willig Protocols and Architectures for Wireless Sensor Networks WILEY (ISBN: 0-470-09510-5)
> 2. Ad Hoc Wireless Networks: Architectures and Protocols by C. Siva Ram Murthy and B. S. Manoj (Prentice Hall, 2004)
> 3. Wireless Sensor Networks: An Information Processing Approach by Feng Zhao and Leonidas J. Guibas (Morgan Kaufmann, 2004)
> 4. Handouts & Online Readings as assigned

Important RIT Deadlines

> Last day of add/drop is Dec. 5, 2005.
> Last day to withdraw with a grade of "W" is Jan. 27, 2005. The deadline for withdrawing from a course with a W grade is the end of the 6th week of the quarter. Forms may be obtained from your department office and need your instructor's signature. The completed forms should be returned no later than Jan. 27, 2005.
> *NOTE*: The department policy states that a student has one quarter to **challenge** any **grade**. After that, grades cannot be challenged.

Course Description

> This course will introduce students to the diverse literature on ad-hoc/sensor networks, and expose them to the fundamental issues in designing and analyzing ad-hoc/sensor network

systems. Students will study related technologies and standards ranging from networking, OS support and algorithms, to security. Of primary concern will be protocol design, communication and computational challenges posed by these systems. Students will construct ad-hoc/sensor networks, program on the sensor hardware, and study the performance of various protocols. Class 4, Credit 4.

Course Learning Outcomes

This course will help students to identify the major issues associated with ad-hoc/sensor networks. Students will explore current ad-hoc/sensor technologies by researching key areas such as algorithms, protocols, hardware, and applications. Students will learn how to program and communicate with embedded operating system such as TinyOS, a prominent application development environment for sensor systems using Motes. At the end of this course students will gain hands-on experience through real-world programming projects on ad-hoc/sensor hardware and be able to implement or develop algorithms involved in ad-hoc/sensor systems.

Intended learning outcomes and associated assessment methods of those outcomes:

1. Students will be able to describe the unique issues in ad-hoc/sensor networks. This will be accessed through assignments and labs.
2. Students will be able to describe current technology trends for the implementation and deployment of wireless ad-hoc/sensor networks. This will be assessed through assignments, and classroom interaction.
3. Students will be able to discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks. This will be assessed through assignments, labs, and classroom interaction.
4. Students will be able to build and configure a testbed for a sensor network. This will be assessed through labs.
5. Students will be able to describe and implement protocols on a sensor testbed network. This will be assessed through assignments, labs, and classroom interaction.

Prerequisites:
4002-342/746 Internetworking Lab and 4002-219 Programming for IT III or a two-course sequence in object oriented programming

Student must be concurrently enrolled in 4050-582/782 Lab.

Role of course in curriculum for:

IT: This is an elective course.
Applied Networking and System Administration: This is an elective advanced work course.

Course required for graduation in:

BS/IT
To which BS/IT program outcome(s) does it contribute?
    D. Program effectively within the student's specialty area
    J. Design and develop a software prototype
    L. Develop specialized IT skills in a self-selected specialty area
    P. Participate effectively as a team member

BS/ANSA
To which BS/ANSA program outcome(s) does it contribute?

Analyze tasks needed to meet user demands.

Program effectively within the student's specialty area.

Identify traits of wired and wireless networks and the advantages/risks of each.

Course Organization

Finishing the assigned readings, attending the lectures, and conducting the labs assignment will help you to get ready for the quiz and exam. *No handwritten assignments will be accepted.*

Written Exams

There will be 3-4 written quizzes.

Labs

1. Environment Setup
2. Sensor Network Basics
3. Sensor Network Applications
4. S-MAC protocol
5. Sensor Network Routing

Homework/Project

Students will form into teams during the 5th week of the term. A project will be assigned and each team will attempt to complete the project, competing with the other teams. Teams will demonstrate their results during final exam week.

Review Paper (for 4055-782 students only)

A paper related to issues in wireless ad-hoc/sensor networking will be assigned. The subject is your choice, but it must be related to wireless ad-hoc/sensor networking. This gives you an opportunity to research a topic of interest to you and receive credit for doing so. Examples of topics include Physical/MAC/Routing layer protocols, System Reliability and Fault Tolerance, Target Detection, Classification and Tracking with Sensor Networks, Data Fusion and Data Management, TCP over Wireless Networks, and Security in sensor network. This will be an individual assignment. The paper must be submitted to **http://www.turnitin.com**, which will check for authentic contribution from you. Details on turnitin.com will be given in the class. You will be required to give a short presentation of your review paper.

Assignment Due Dates and Grading

The Homework and Term Paper assignments are due on the dates specified by the instructor. Failure to submit your assignment on time will result in a grade reduction according to the following schedule. The percentage grade reduction will be calculated using the highest possible grade for that assignment.

Amount Late	Reduction In Grade
One day late	10%

Two days late	20%
Three days late	30%
More than three days late	100% (a zero for the assignment)

Extremely extenuating circumstances may be accepted as a valid excuse for not handing an assignment in on time (requires verification). You must notify the faculty member **in advance,** i.e. before the due time of the assignment.

Mycourses.rit.edu

Any announcements on the deadlines and other material related to this course will be posted in the http://mycourses.rit.edu. Check the postings in this website regularly.

Course Outline

Course Topics

1. Introduction of ad-hoc/sensor networks
    1.1. Key definitions of ad-hoc/sensor networks
    1.2. Advantages of ad-hoc/sensor networks
    1.3. Unique constraints and challenges
    1.4. Driving Applications
2. Wireless Communications/Radio Characteristics
3. Ad-Hoc wireless networks
4. Media Access Control (MAC) Protocols
    4.1. Issues in designing MAC protocols
    4.2. Classifications of MAC protocols
    4.3. MAC protocols
5. Routing Protocols
    5.1. Issues in designing routing protocols
    5.2. Classification of routing protocols
    5.3. Routing protocols
6. Networking Sensors
    6.1. Unique features
    6.2. Deployment of ad-hoc/sensor network
    6.3. Sensor tasking and control
    6.4. Transport layer and security protocols
7. Sensor Network Platforms and Tools
    7.1. Berkley Motes
    7.2. Sensor network programming challenges
    7.3. Embedded Operating System
    7.4. Simulators
8. Applications of Ad-Hoc/Sensor Network and Future Directions.
    8.1. Ultra wide band radio communication
    8.2. Wireless fidelity systems

Grading
The grading scale used along with the grading criteria is as follows:

Component	582 Weight	782 Weight
Quizzes	30	20
Labs	35	30
Project proposal	5	5
Group Project	30	30
Review Paper		15

Range	Grade
>= 90.0%	A
>= 80.0% & < 90%	B
>= 70.0 % & < 80.0%	C
>= 60.0 % & < 70.0%	D
< 60.0%	F

Course Schedule

Week	Topics/Exams	Assigned Reading	Activities
1	Introduction of wireless ad-hoc/sensor networks	Review articles on wireless ad-hoc/sensor networks	Lab1
2	Architecture of sensor hardware and software	TinyOS documents	Lab2
3	MAC Layer in wireless Networks	Articles on MAC	Lab3
4	MAC in Sensor Networks	Articles on MAC	Lab4
5	Routing in Ad-hoc/Sensor Networks	Articles on Routing	Lab5
6	Routing in Ad-hoc/Sensor Networks	Articles on Routing	Start Projects
7	Routing in Ad-hoc/Sensor Networks	Articles on Routing	Project proposal due
8	Transport Layer, Data Aggregation, Middleware	Articles on Transport layer	Projects
9	Security in Wireless Ad-hoc/Sensor Networks	Articles on security	
10	/ Catch-up		
11	**Final Exam**		Demo Projects during final exam time

Cheating Policy: Please review the departmental policy on cheating as described at http://www.it.rit.edu/policies/dishonesty.html or See attached copy.

Student Responsibilities: Please review the general student responsibilities as outlined at http://www.it.rit.edu/~netsyslab/Responsibilities.htm

Finally...

Any or all of the previous information is subject to change or modification during the quarter.