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

### Instructor:

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<thead>
<tr>
<th>Name: Dr. Xiaojun Cao</th>
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<tbody>
<tr>
<td>Office: Bldg. 70-2321</td>
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<tr>
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<thead>
<tr>
<th>Name: Dr. Nirmala Shenoy</th>
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</tbody>
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### Office Hours:

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:

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](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.

<table>
<thead>
<tr>
<th>Amount Late</th>
<th>Reduction In Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>One day late</td>
<td>10%</td>
</tr>
</tbody>
</table>
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
   8.1. Ultra wide band radio communication
   8.2. Wireless fidelity systems

Grading

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

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics/Exams</th>
<th>Assigned Reading</th>
<th>Activities</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction of wireless ad-hoc/sensor networks</td>
<td>Review articles on wireless ad-hoc/sensor networks</td>
<td>Lab1</td>
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<tr>
<td>2</td>
<td>Architecture of sensor hardware and software</td>
<td>TinyOS documents</td>
<td>Lab2</td>
</tr>
<tr>
<td>3</td>
<td>MAC Layer in wireless Networks</td>
<td>Articles on MAC</td>
<td>Lab3</td>
</tr>
<tr>
<td>4</td>
<td>MAC in Sensor Networks</td>
<td>Articles on MAC</td>
<td>Lab4</td>
</tr>
<tr>
<td>5</td>
<td>Routing in Ad-hoc/Sensor Networks</td>
<td>Articles on Routing</td>
<td>Lab5</td>
</tr>
<tr>
<td>6</td>
<td>Routing in Ad-hoc/Sensor Networks</td>
<td>Articles on Routing</td>
<td>Start Projects</td>
</tr>
<tr>
<td>7</td>
<td>Routing in Ad-hoc/Sensor Networks</td>
<td>Articles on Routing</td>
<td>Project proposal due</td>
</tr>
<tr>
<td>8</td>
<td>Transport Layer, Data Aggregation, Middleware</td>
<td>Articles on Transport layer</td>
<td>Projects</td>
</tr>
<tr>
<td>9</td>
<td>Security in Wireless Ad-hoc/Sensor Networks</td>
<td>Articles on security</td>
<td></td>
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<tr>
<td>10</td>
<td>/ Catch-up</td>
<td></td>
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<tr>
<td>11</td>
<td>Final Exam</td>
<td></td>
<td>Demo Projects during final exam time</td>
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**Cheating Policy:** Please review the departmental policy on cheating as described at [http://www.it.rit.edu/policies/dishonesty.html](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](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.